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TRANSACTIONS

OF THE

TWENTY-EIGHTH AND TWENTY-NINTH ANNUAL MEETINGS

OF THE

KANSAS ACADEMY OF SCIENCE.

(1895-1896.)

EDITED BY THE LIBRARIAN.

VOLUME XV.

PRINTED BY
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THE TWENTY-EIGHTH ANNUAL MEETING.

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TWENTY-EIGHTH ANNUAL MEETING.

PROCEEDINGS.

The Kansas Academy of Science convened for the twenty-eighth meeting in the lecture room of Snow Hall, Kansas University, Lawrence, January 2, 1896, at 3 P. M. President Knaus in the chair.

The secretary called the roll, and the following members responded to their names: E. B. Knerr, Warren Knaus, D. E. Lantz, E. C. Murphy, E. Miller, L. E. Sayre, F. H. Snow, T. H. Dinsmore, jr., W. A. Snow, D. S. Kelly, A. H. Thompson, B. B. Smyth, J. T. Lovewell, E. Haworth, J. T. Willard. A number of visitors were present, and before adjournment other members appeared, having arrived on later trains.

Committees were appointed by President Knaus, as follows:

On program and press: L. E. Sayre, T. H. Dinsmore, jr., W. A. Snow.

On membership: E. C. Murphy, D. S. Kelly, E. Miller.

On resolutions: A. H. Thompson, E. B. Knerr, B. B. Smyth.

On nominations: F. H. Snow, S. W. Williston, J. T. Lovewell.

On time and place for next meeting: E. Haworth, D. E. Lantz, J. T. Willard.

Secretary read the correspondence which had accumulated during the year.

President Knaus made a verbal report on the printing of volume XIV of the Transactions.

In the evening President Knaus delivered the retiring president's address, which was highly appreciated by the members present, inasmuch as the history of the Academy was reviewed, and the more important papers that have thus far been presented were classified and commented upon.

After the president's address was concluded, various topics of a business interest to the Academy were discussed, chiefly relative to the division of the Academy into sections, appropriations by the legislature, the preparation of monographs on the natural resources of Kansas.

A. H. Thompson read a paper (1) "On the publication by the Academy of scientific monographs on the natural resources of Kansas."

On motion, the chair appointed as committee on monographs, A. H. Thompson, E. Haworth, S. W. Williston.

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A committee on necrology was appointed, as follows: A. H. Thompson, F. H. Snow, E. B. Knerr.

Chairman Dinsmore, of program committee, announced the program for the next session.

JANUARY 3, 1897.

Academy convened at 9:30 A. M. Secretary read minutes of previous session. Treasurer's report was read, and an auditing committee appointed, consisting of D. E. Lantz, A. H. Thompson, E. B. Knerr.

The membership committee reported a list of applicants; all were duly elected.

The reading of papers was then taken up, and the following heard:

2. Notes on frosted poor-will, D. E. Lantz.
3. Color photography, E. B. Knerr.
4. An improved clinometer, Alva J. Smith.
5. A new theory of the surface markings of the moon, E. Miller.
6. Telephonic communications with light-ships, L. I. Blake.
7. The new elements argon and helium, E. C. Franklin.

The committee on necrology reported that during the year Prof. Robert Hay, Prof. D. H. Robinson and I. B. Ashton had died. Appropriate resolutions were reported, adopted, and entered on the minutes of the Academy.

Adjourned to meet at 2 P. M.

Academy convened at 2:30 P M. Librarian B. B. Smyth made his annual report, which was duly accepted.

On motion, the librarian was authorized to dispose of 350 copies of the reprint edition of volumes I to III at 50 cents per set, to reimburse the treasury for the expense of the reprint.

Reading of papers was then resumed.

8. An experiment in rain-making, T. H. Dinsmore.
9. A polished glacial rock near Topeka, J. T. Lovewell.
10. Foucault's pendulum experiment, J. T. Lovewell.
11. A new drill hole in Wichita, J. R. Mead.
12. Cone-in-cone structure, H. J. Harnly.
13. Closing of the Michigan glacial lakes, B. B. Smyth.
14. Salt beds of Kansas, M. Z. Kirk. In the absence of the author, this subject was presented by Prof. E. Haworth.
15. The flint hills: an object-lesson in physiography, E. Haworth.
16. Horsebacks in coals of Cherokee and Crawford counties, W. R. Crane.
17. Water storage in Dakota formation in Kansas, S. Z. Sharp.
18. On extinct bison from western Kansas, S. W. Williston.

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19. Irrigation in Cheyenne county, W. N. Logan.

The auditing committee reported that they had carefully examined bills, accounts and entries of the treasurer, and found them in every respect as presented in his report. Report received, and the committee discharged.

Committee on nominations reported:

For president, D. S. Kelly, Emporia.

First vice-president, S. W. Williston, Lawrence.

Second vice-president, D. E. Lantz, Manhattan.

Secretary, E. B. Knerr, Atchison.

Treasurer, L. E. Sayre, Lawrence.

Librarian, B. B. Smyth, Topeka.

Curators: A. H. Thompson, Topeka; B. B. Smyth, Topeka; G. P. Grimsley, Topeka.

On motion, the secretary was instructed to cast the vote of the Academy for the above officers.

B. B. Smyth reported that 1,500 bound and 500 unbound copies of volume XIV would be issued by the state.

Dr. L. E. Sayre then presented his paper (20) on "Serum Therapy," in the form of an illustrated lecture with lantern views.

After the lecture by Doctor Sayre, the Academy, by invitation, adjourned to the rooms of the library building, where an hour of pleasant social intercourse was enjoyed, followed by a unique banquet under the hostship of the University science club "It."

JANUARY 4, 9:30 A. M.

Academy convened, with President Knaus in the chair. President elect D. S. Kelly was called to take the chair, and in doing so responded in a fitting address.

Minutes of the previous session were read.

The committee on monographs reported as follows:

Your committee appointed to investigate the matter of publishing scientific monographs by the Academy upon the natural resources of the state desire to submit the following: They would recommend the inauguration of the scheme proposed in the communication by Dr. A. H. Thompson, and to that end recommend the appointment of a committee to carry forward the work of receiving the material for the first volume on geology, to be submitted at the next meeting of the Academy.

A. H. THOMPSON,
S. W. WILLISTON,
Committee.

The report was adopted, and S. W. Williston, E. Haworth and G. P. Grimsley were appointed a committee to edit the first monograph.

The committee on time and place of next meeting reported in favor of Topeka, and the Christmas holiday week, either immediately before

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the meeting of the State Teachers' Association or immediately after; the exact dates to be announced later by the secretary.

The reading of papers was then resumed:

21. Some geometrical theorems, Arnold Emch.

22. Notes on injurious insects, W. A. Snow.

23. Notes on Kansas coleoptera, Warren Knaus.

24. Restoration of saber-toothed cat from White River miocene, E. S. Riggs.

25. A theory of absorption spectra, A. S. Dunstan.

26. Notes on discharge of Kansas river since 1881, E. C. Murphy.

27. Geology of Shawnee county, J. W. Beede.

28. Stratigraphy from Atchison to Washington counties, E. B. Knerr.

The committee on resolutions reported the following, which was adopted:

Resolved, That the Kansas Academy of Science express to the faculty of Kansas University and friends their high appreciation of the kindness extended in the generous entertainment of the Academy and visitors; and to the science club sincere thanks for the very acceptable and suitable introduction into the mysteries of the "It."

A. H. THOMPSON,
B. B. SMYTH,
E. B. KNERR,
Committee.

At the various sessions of this meeting, the following new members were duly elected: J. W. Stailey, Lawrence; Elam Bartholomew, Rockport; C. N. Gould, Maple City; W. G. Riste, Phillipsburg; C. S. Caldwell, Topeka; T. D. A. Cockerell, Las Cruces, N. M.; H. C. Welty, Topeka; E. E. Tyler, Lincoln, Neb.; T. M. Aderhold, Topeka; Chas. H. Sternberg, Lawrence; G. P. Grimsley, Topeka; W. R. Crane, Lawrence; W. N. Logan, Beloit; J. W. Wilson, Effingham; E. S. Riggs, Lawrence; Barnum Brown, Carbondale; Lottie E. Crary, Council Grove.

On motion, the secretary was authorized to arrange the papers for next year's meeting according to the departments of science of which they treat.

The time for the hearing of papers having expired, the following were ordered, on motion, to be read by title:

29. Notes on the evaporation from soil and sand, E. C. Murphy.

30. Electric resonance in circuits possessing mutual induction, A. S. Dunstan.

31. Simple sounds of the English language, J. H. Carruth.

32. Additions to Goss's Revised Catalogue of Kansas birds, V. L. Kellogg.

33. Germination of Commelina and Tradescantia, J. B. S. Norton.

34. New fungi, Elam Bartholomew.

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35. Coleoptera of Saline county, and notes on habits and distribution, A. W. Jones.

36. Entomological collections of Kansas University, W. A. Snow.

37. On the occurrence in America of the European ortalid genus Phairoptera, W. A. Snow.

38. The Dakota formation in western Kansas as a water-bearing terrane, E. Haworth.

39. On the dermal covering of Hesperornis, S. W. Williston.

40. Additions to the list of Kansas coleoptera, W. Knaus.

41. Changes in the channel of the Missouri river at Atchison, E. B. Knerr.

42. Tetra-chlor-meta-nitro-benzaldehyde, H. P. Cady.

The Academy then adjourned, to meet at Topeka in accordance with a previous motion.

E. B. KNERR, *Secretary.*

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TRANSACTIONS.

A NEW THEORY OF THE SURFACE MARKINGS OF THE MOON.

By E. MILLER, Lawrence, Kan. Read before the Academy January 3, 1896.

Our next-door neighbor, the Moon, although so near, has its mysteries. The problems arising from the lunar theories are so many and of such complex nature that as yet no complete solution of them has been reached. The dominant features are the craters; and it is practically true that all lunar theories begin with them. The mountain ranges, the craters, the cracks and the seams upon the Moon, are clearly and distinctly defined with the assistance of a good telescope; and by means of the art of the photographer, there are to-day better maps of the lunar surface that is exposed to our view than any maps ever constructed of a corresponding portion of the Earth's surface.

Three theories have attracted considerable attention, to which a large amount of industry, patience and enthusiasm has been given. If not considered presumptuous, I shall add another theory, one that is entirely new and original, so far as is known. A brief outline of the first, second and third will be given before touching upon the fourth. The first is known as the "volcanic theory," the second as the "meteoric," and the third as the "tidal theory."

All known active and extinct terrestrial craters are volcanic beyond a doubt, and the great mass of writers affirm the same to be true of the lunar craters, all of which that are exposed to our view being, however, of the extinct variety. No craters upon our globe begin to approximate in size the largest of the Moon. There are lunar craters 800 miles in diameter, and they range from that size down until they become imperceptible. Those large plains upon our lunar surface, heretofore called seas, and of oval outline, are now by some classed as craters. The largest known crater upon Earth does not exceed 17 miles in diameter. Volcanic action upon our neighbor, the Moon, must have been in its day much more terrific than anything of a similar nature upon our own planet. The number of lunar craters visible to us is somewhere in the neighborhood of 30,000. Estimating one-half the Moon's surface at about 7,000,000 square miles, and the surface of North America, excluding Greenland and the West India islands, at 8,000,000, we shall find by the most reliable statistics that North America has only one-tenth as many craters, both active and extinct, as one-half the Moon's total surface. This apparent discrepancy may be accounted for when it is considered that upon the Earth two powerful agencies—aqueous and atmospheric—have been at work for perhaps millions of years, producing a demolition of craters, or burying them under successive layers of geologic debris. Without discussing the "volcanic theory" in detail, this simple reference to it must be considered sufficient.

Mr. G. K. Gilbert delivered a very able and interesting address December 10, 1892, before the Philosophical Society of Washington, on "The Moon's Face," of which the following may be considered the main thought: Basing his discussion upon the supposition that when the Moon was in the form of a ring similar to the rings of Saturn the time came when the stability of the lunar ring was destroyed and an indefinite number of moonlets, constituting in fact, a meteoric swarm, resulted. Under the superior attraction of one or more of the largest

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masses, a trend toward that one was set up, and the impacts or collisions thus produced not only fused the striking meteorite but also that portion of the nucleus that was struck. A coalescence took place, the central body grew in size, and its power of attraction increased accordingly. In harmony with the laws of celestial dynamics, the velocity of the moonlets toward the central controlling mass would increase, and the energy expended would be sufficient to melt every moonlet, even though it should be composed of the most refractory substance. The portion of the surface of the central mass struck by the moonlet would itself be fused, and there would be formed a cup-shaped depression similar to the crater forms now seen upon the Moon, together with their attending phenomena. The larger the moonlet, the larger and deeper would be the depression and the greater the fusion of the rock material. The smaller the moonlet, the shallower would be the crater's depth, and less its diameter. I have seen in the cuts and gullies made by the overflow, and backwater, and subsequent subsidence, of the San Pedro river in southern Arizona, the plastic mud deposited by the falling waters of such consistency, that when a pound or two-pound rock was dropped into that mud, an examination of it next day showed a crater-like form resembling exactly the forms of the lunar craters, taking the normal type as an example.

"If a drop of water be made to fall on a still surface of water, the outward-moving annular wave at one instant incloses a crater; at the next instant a mound rises in the center of the crater." In the case of the viscous mud, as shown in the example of the San Pedro, if a stone fall from a certain height, "a cup-like cavity or crater with a smooth rim will be produced; if it fall from a greater height it will produce a larger cup with smooth rim and smooth dome-like hill in the center." An experiment of this sort can easily be performed. The white streaks, constituting one of the great lunar features, is by this theory of impact also accounted for. According to Dr. B. A. Gould, "The most remarkable appearance of the Moon, for which nothing on Earth furnishes an example, is presented by those immense radiations from a few of the larger craters — perfectly straight lines, as though marked with chalk along a ruler — starting from the center of the crater and extending to great distances over every obstruction. My explanation is, that a meteorite, striking the Moon with great force, spattered some whitish matter in various directions. Since gravitation is much feebler on the Moon than with us and atmospheric obstruction of consequence does not exist, the great distance to which the matter flew is easily accounted for." Accepting the premises on which the "meteorite theory" is based as true, all the characteristics of the Moon's surface — craters, streaks, central domes, rising from the floors of the craters, and even the building of the Moon itself — can be explained on the theory of the impact of moonlets or meteorites upon the central mass.

But it may be stated that the impact of the larger masses upon the central one, in order to produce results such as we see on the Moon's surface, is a theory that contains inherent and radical difficulties. The diameter of the Moon is about 2,100 miles, and by this theory we have a moonlet whose impact was capable of producing a crater 800 miles in diameter. We may reasonably suppose that when the lunar ring was broken into fragments, the central mass may not have had a diameter of over 1,000 miles and collisions would take place not long after the dismemberment. A collision between two bodies, one 1,000 miles in diameter and the other 800 miles in diameter, would break both bodies into a multitude of smaller bodies, and hurl them outward into space in a thousand different directions. This process would be carried on just as fast as the meteoric masses of the old ring should be drawn towards the center. A swarm of asteroids would therefore, under such conditions, have taken the place now occupied

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by the Moon. Yet it is fair to assume that the "meteoric theory" is true as one of the factors in any lunar theory that may be advanced. The volcanic is also another factor that must be considered as equally important. There is, therefore, no objection to the statement that both forms of action, the volcanic and the impact of meteors, may have had each its due share in bringing about the present condition of the Moon's surface.

The third or "tidal theory" supposes a time when the Moon was liquid but covered with a thin crust. "The Moon then rotated more rapidly than now, and great tides, excited by the Earth's attraction, rocked and cracked its crust, and here and there squeezed out a portion of the liquid nucleus, which flowed back again when the tidal wave had passed; but congelation caught the flood at its edges, so as to mark its limit by a solid ridge. By each successive tide the operation was repeated, with the result that the wall was given a circular form and was gradually built up. The process was finally closed by the congelation of lava in the orifice, and while the congelation was in progress the last feeble eruption sometimes produced a central hill." The tidal theory is quite strong in certain directions, while in others it is weak.

I now desire to pass by these three forms or theories, and construct another which may or may not have merit of its own; a system of lunar dynamics, which, so far as I know, has never been looked at in the light in which I now propose to consider it. The suggestion is pertinent right here, that this fourth theory does not leave out of sight the other three as factors of importance in the solution of the problem in hand.

After the Moon had collected her material together into the form of a globular mass, and before becoming a rigid body as it is now known to be, that is when still a gaseous or liquid body, there is scarcely a doubt as to the existence of a force within the Moon powerful enough to produce each and all the peculiar markings on the lunar surface. The most important member of the solar system, the Sun, is in either a gaseous or liquid state, and has been so for millions of years, and will continue to be so for millions of years more. During all these years the sun has been, and will continue to be, diminishing in size at the rate of about 250 feet in diameter per year. The annual contraction of the Sun's mass will in time not only solidify the Sun, but diminish very rapidly toward the end the amount of heat given off. Finally, the condition of the Sun may become that of a cold, dark body, destitute of both heat and light, and if there be no atmosphere and aqueous vapor such as we are acquainted with, then the solar surface will present an appearance similar to that of the Moon—a surface covered with mountain ranges and peaks, craters, fissures, and streaks. But if an atmosphere and aqueous vapor should be in existence at that remote time of the future, then surface markings resembling those of the earth will characterize the surface of the Sun.

The contraction of the Sun at the rate of 250 feet per annum is sufficient, according to the theory of celestial dynamics, to produce all the heat the sun now gives off, and moreover is enough for that purpose until the Sun is diminished to the size of a body sensibly smaller than now. This contraction of the Sun and the consequent radiation of heat may in part be the form of energy, or one of the forms of energy, in operation upon and within the Sun, to which the sun-spots owe their origin. Sun-spots range in diameter from 500 to 100,000 miles or even more, and the penumbra is still greater. As to their depth, they seldom exceed 2,500 miles, although in one instance, observed by Mr. Langley, the enormous depth of 5,000 miles was probably reached.

The force, or forces, at work upon and within the Sun will, after the lapse of

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ages, leave the body of the Sun in a viscous condition, and spots formed under such circumstance will become permanently fixed in the form of craters possessing the essential characteristics of the lunar craters. Not only the forms that are typical or normal, but those that are broken and misshapen, with rims, in some cases elevated several thousands of feet above the surrounding surface, but slightly pushed up in others; with cavities reaching in some instances to immense depths; and with fissures and streaks, in straight or irregular lines, will all be found to dot the solar surface as abundantly as do those upon the face of the Moon. If there should be neither atmosphere nor moisture, then and there, all the rugged forms and appearances, the precise counterparts of those upon the Moon, will mark the period when the Sun will have ceased to radiate heat and light throughout the solar system, and will have become a dark, dead body, ready for some great catastrophe by which it may be transformed into another and perhaps more beautiful system.

Taking the Sun as an example of a mode of action, is it beyond the realm of truth and of science to formulate a theory for the Moon similar to that which is now at work, and is actually passing before our eyes, upon the Sun? The nebular hypothesis gives us a starting-point — a lunar ring, at first complete it may be, then broken into a multitude of fragments. Gravitation molded these fragments into a veritable planet that was to be our nearest neighbor. In its earliest stages, the Moon was not a solid, rigid body, but a mass of gaseous or liquid matter in a condition of white heat. In time it contracted its volume; heat was evolved; and intense action set up in the mass. The results would be noticeable upon the surface; and manifestations of protuberances and other phenomena, similar to those of the Sun, would naturally follow. As the ages rolled by, the heat would disappear in part by radiation, and partly by absorption, to be stored away as latent heat. As there was no atmosphere nor moisture, the resulting form of the Moon's surface then would constitute a photograph of its condition true to life as long as the solar system should endure.

In conclusion, therefore, is not the assumption that the Moon-spot theory, to coin a term, is in sufficient harmony with well-established mathematical and dynamic principles to constitute a theory of as great importance as any other, and perhaps more satisfactory in that it meets the conditions of astronomical science at all points?

This fourth theory does not claim to discard entirely the volcanic agencies, or the impact of meteors, or tidal action, but it does claim to be more general in its operations, more wide-reaching, and yet allowing to a certain extent the agencies of other forces as restricted and collateral, within limits.

The contraction of the Sun's mass, the development of heat, and the immense energy consequent upon that development, as seen in splendid outbursts of the protuberances, the formation of sun-spots which, crossing the Sun's disc, present such wonderful changes in form, size, and movement, may not all this be but a transcript of the story that the Moon might tell concerning the events that took place upon and within the lunar mass millions of years ago? May not the present condition of the Moon's surface be a prophecy of what the Sun's will be in the far-distant future?

The energy of lunar heat when the Moon was an incandescent body must have manifested itself in results similar to those which the energy of solar heat now produces. The one is but a type of the other.

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NOTES ON THE FROSTED POOR-WILL.

Phalœnoptilus nuttalli nitidus, Brewster.

Synopsis of paper read before the Academy January 2, 1896, by D. E. LANTZ, Manhattan, Kan.

This subspecies of the Poor-will was first described by Mr. Wm. Brewster in *The Auk* for April, 1887, the type specimen having been taken on the Nueces river, Texas, February 27, 1886, by F. B. Armstrong, and the geographical range of the birds being given as Texas and Arizona. Mr. Brewster noted the occurrence of both *nuttalli* and *nitidus* in the Catilina mountains of Arizona, and suggested that possibly the two forms breed at different altitudes, or that the frosted might be only a migrant in that locality.

In *The Auk*, Vol. VI, p. 124, April, 1889, and in the Transactions of this Academy, Vol. XII, p. 24, the late Colonel Goss announced the addition of this bird to the avifauna of Kansas, his specimen having been taken at Neosho Falls, September 23, 1881. In his final work on the Birds of Kansas, Colonel Goss remarks concerning this subspecies: "This bird does not differ in habit, actions, or size from *P. nuttalli*, and I am impressed with the thought that it may possibly prove to be a dichromatic phase like that of the screech-owl rather than a subspecies as now entered." This impression was also expressed by him in *The Auk*, Vol. VII, p. 286.

A few reasons may properly be here introduced for sharing in the opinion so modestly stated by Colonel Goss. For several years I have been careful to observe the color phase of every poor-will met with in the daytime. The frosted form is easily distinguished at a distance of two or three rods. About one-fourth of all the individuals seen were frosted. While I have never seen both forms of the adult birds together as mates, I have flushed one of each from the same hillside within a few rods of each other. My conclusion that they were mates may have been unwarranted. Unfortunately, in the three cases where Mr. Blachly found the eggs in Riley county, only a single parent bird was captured, and in each case the bird was of the frosted form. In the several cases where I have found the eggs, either both parents were of the older form, *nuttalli*, or only a single parent was seen, and it of that form.

On May 25, 1889, I found a nest in which were two young birds nearly ready to fly. They were unequally developed. The larger I should judge to have been about four days older than the other. It showed only the ordinary color phase, but the other bird showed the conspicuous white markings of *nitidus* on the wings and tail feathers, although the latter were but little developed. There was only one parent bird to be seen and it was typical *nuttalli*. All efforts to find the other parent were unsuccessful.

Both varieties of the poor-will breed in similar situations near Manhattan. They are found near together, in one case in the same nest, cared for by the same parent. There is no perceptible difference in size, habits, notes, eggs, or in any particular except coloration. Both varieties are found in Texas, New Mexico, Arizona, and Kansas, while intermediate forms are reported from southern California. The Death Valley exploring expedition in 1891, found no specimens of *nitidus;* but *nuttalli* was quite common. Further investigation is necessary to establish the fact of dichromatism in the poor-will; but the observations of the writer thus far made strongly support the theory.

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ADDITIONS TO GOSS'S REVISED CATALOGUE OF THE BIRDS OF KANSAS.

By VERNON L. KELLOGG, Stanford University, Calif. Read by title January 4, 1896.

Since the publication of Col. N. S. Goss's "Revised Catalogue of the Birds of Kansas" (May, 1886), a number of species not included in the catalogue have been noted in the state. Most of these additions have been recorded singly in *The Auk*, but in order that they may be referred to conveniently I have here arranged these additions in the form of a supplement to the catalogue, continuing the numbering of the catalogue and maintaining the style of entry and reference used by Colonel Goss. Indeed, the additions consist largely of observations made and recorded by Colonel Goss since the publication of the catalogue, and it is but a small service to the memory of a revered friend that I offer in the collation of these observations. A few notes regarding certain of the birds included in the catalogue are added for the purpose of making it as nearly as possible an up-to-date reference list of the Kansas bird fauna.

ADDITIONS.

336. *Æchmophorus occidentalis.* WESTERN GREBE.—A single specimen, a young male, was taken November 3, 1887, on the Kansas river at Lawrence. Prof. F. H. Snow obtained the bird of a young negro, and the specimen is now in the collection of the University of Kansas.

337. *Somateria v. nigra.* PACIFIC EIDER.—A single specimen, a young male, was taken by A. L. Weidman, a hunter, on the Kansas river about six miles from Lawrence. The specimen is now in the collection of the University of Kansas.

338. *Oidemia perspicillata.* SURF SCOTER.—A single specimen was taken October 29, 1887, by Mr. A. L. Bennett, on the Kansas river at Lawrence. The specimen is now in the collection of the University of Kansas.

339. *Chen cærulescens.* BLUE GOOSE.—This species, at the time Colonel Goss's catalogue was issued, had been dropped from the A. O. U. Check-List, in which it once appeared as an accepted species (No. 169), and had been placed in the hypothetical list, "on account of the possibility that it is a colored phase of *Chen hyperborea* (Pall.)" Since then the form has been declared a valid species (see Abridged Edition, Revised A. O. U. Check-List, p. 16, 1889). Colonel Goss in his catalogue stated his belief that the form would "eventually be declared a valid species." In his first "Catalogue of the Birds of Kansas," 1883, *cærulescens* is entered as "migratory, rare."

340. *Grus canadensis.* LITTLE BROWN CRANE.—"Migratory, not uncommon; arrives in March, returns the last of October. Omitted from catologue by oversight." (*Goss*, History of Birds of Kansas, p. 133, 1891.)

341. *Ionornis martinica.* PURPLE GALLINULE.—A single specimen was killed in Riley county April 14, 1893, by a farmer, and came into the possession of Dr. C. P. Blachly, of Manhattan.

342. *Ægialitis nivosa.* SNOWY PLOVER.—In the Trans. Kan. Acad. Sci., Vol. x, p. 783, 1886, Colonel Goss says this bird is a common summer resident on the salt plains along the Cimarron river in the Indian territory, the northern portion of these salt plains extending across the line into southwestern Comanche county (Kan.) The birds arrive about May 1, and begin laying in the latter part of

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the month. The nest is simply a depression worked out in the sand. Eggs, three, 1.20 x .90, pale olive-drab, approaching a light clay color, with a greenish tint, rather evenly and thickly marked with irregularly-shaped, ragged-edged splashes and dots of dark or blackish brown. Colonel Goss shot two birds June 18, 1886, on the Kansas plains, and saw a female with two half-grown young. Just south of the line (in the Indian territory), he saw several of the birds, and startled one from a nest in the sand. In the "History of the Birds of Kansas," Colonel Goss refers to this bird as being "quite common [in the limited part of the state above referred to.]"

343. *Colinus virginianus texanus.* TEXAN BOB-WHITE.—"This southwestern race, as a bird of central Kansas, rests on two specimens, adult females, in the U. S. National Museum, collected May 29, 1864, by Dr. Elliott Coues, on the Republican river, in the northwestern part of the state. I have been informed by military men and hunters that Bob-whites were occasionally seen on the Cimarron river south of Fort Dodge from 1862 to 1866. This was long before our birds, in following up the settlements, had reached the central portion of the state, and it is safe to conclude that the birds found there were of this variety (*texanus*); and that they reached that vicinity by following the old military trail north through the Indian territory for the grains scattered along the route at feeding and camping places. Of late years the trail has been little used, and as the country was without settlement, their disappearance can be accounted for on the ground that they have been destroyed by enemies, or, for want of food and shelter, could not survive the cold winters." (*Goss*, History of the Birds of Kansas, p. 222.)

344. *Picicorvus columbianus.* CLARKE'S NUT-CRACKER.—"An occasional visitant. Mr. L. L. Jewell, of Irving, kindly sent me for examination a portion of a skin saved from a small bird shot August 13, 1888, by Mr. Charles Netz, near the south line of Marshall county." (*Goss*, History of the Birds of Kansas, p. 386.) Mr. H. W. Menke saw three birds in Finney county on October 10, 1891, and on the day before five birds were seen at Emporia, in the eastern part of the state.

345. *Carpodacus mexicanus frontalis.* HOUSE FINCH.—Five birds were taken out of a flock of 15 on January 5, 1892, by Mr. H. W. Menke, in Finney county. The species is common in Colorado and further west.

346. *Spizella monticola ochracea.* WESTERN TREE SPARROW.—"Winter sojourner in the western to middle portions of the state; rare or casual in the eastern portion. Leave about the first of April; return in October." (*Goss*, History of the Birds of Kansas, p. 460.)

347. *Piranga ludoviciana.* LOUISIANA TANAGER.—A male was taken by Mr. H. W. Menke on May 20, 1893, in Finney county. On June 1, 1893, several pairs were seen in a small cottonwood grove in Kearny county (adjoining Finney county).

348. *Dendroica cærulescens.* BLACK-THROATED BLUE WARBLER.—One specimen (female) taken by Mr. H. W. Menke in a deserted farm house in Finney county on October 17, 1891. The species belongs to the fauna of the eastern states.

349. *Hesperocichla nævia.* VARIED THRUSH.—A single specimen taken by Mr. H. W. Menke on October 17, 1891, in Finney county.

Thus, the number reached in the cataloguing of the Kansas birds is 349. This, however, is not the true number of valid entries, two eliminations being necessary (see *postea*). The number of species and varieties of which valid records of occurrence within Kansas have been made is 347.

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ELIMINATIONS AND SUBSTITUTIONS.

In the light of the conclusions reached by Dr. Jonathan Dwight, jr., in his study of the Horned Larks of North America (see *The Auk*, Vol. ——. p. 138, *et seq.*, April, 1890) *Otocoris alpestris*, in Colonel Goss's catalogue (No. 180) as a rare winter sojourner, should not be listed as a Kansas bird.

I suggest that *Anas obscura*, Black Duck, No. 24 of the catalogue, be dropped from the list of Kansas birds. No authentic record of the capture of this form in the state is known. See, also, Goss's "History of the Birds of Kansas," p. 55.

Anas fulvigula, Florida Duck, No. 25 of the catalogue, should be replaced by *Anas fulvigula maculosa*, Mottled Duck. Colonel Goss says (*Auk*, Vol. VII, p. 88, Jan., 1890): "In my revised Catalogue of the Birds of Kansas, I entered this bird as the Florida Duck (*Anas fulvigula*). Mr. Sennett, in the July number of *The Auk* for 1889, describes a new duck from Texas, viz., Mottled Duck (*Anas maculosa*), to which I find, upon examination, the Kansas bird should be referred, instead of to the Florida Duck as given." Since the publication of Colonel Goss's note in *The Auk*, the species *maculosa* has been degraded to a variety of *fulvigula*.

Phalœnoptilus nuttalli,* Poor-will, No. 163 of the catalogue, should be replaced by *Phalœnoptilus nuttalli nitidus*, Frosted Poor-will. Colonel Goss says (*Auk*, Vol. VI, p. 124, April, 1889): "A single specimen, a female shot by me at Neosho Falls, September 23, 1891, entered [in the catalogue] as *Phalœnoptilus nuttalli*, has been since identified as this form [var. *nitidus*]." In his "Birds of Kansas," Colonel Goss says that this form, when better known, will without doubt prove to be a common summer resident.

For *Zonotrichia intermedia*, No. 225 of the catalogue, should be substituted *Zonotrichia leucophrys intermedia*. See note by Ridgway in *The Auk*, Vol. VII, p. 96, Jan., 1890; and record of action of A. O. U. committee on nomenclature, *Auk*, Vol. VII, p. 65, Jan., 1890. The form *leucophrys* has been found to intergrade with *intermedia*.

For *Buteo harlani*, No. 122 of the catalogue, should be substituted *Buteo borealis harlani*. See *Auk*, Vol. VII, p. 205, April, 1890, note by Ridgway; and also record of action of A. O. U. committee on nomenclature, *Auk*, Vol. VIII, p. 88, Jan., 1891. The form *harlani* intergrades with *borealis*.

Botaurus exilis, No. 52 of the catalogue, should be *Ardetta exilis*, the genus *Ardetta* Gray being now recognized as a distinct genus, instead of a sub-genus of *Botaurus*. See record of action of A. O. U. committee on nomenclature, *Auk*, Vol. X, p. 61, Jan., 1893.

NOTES ON OCCURRENCE AND BREEDING.

The Pied-billed Grebe, *Podilymbus podiceps*, an account of the discovery by A. L. Bennett and myself of whose nesting in the state was recorded in the catalogue, was found nesting in Meade county, June 8, 1886, by Colonel Goss. I have also noted it nesting on a pond in Douglas county.

Forster's Tern, *Sterna forsteri*, entered in the catalogue as "migratory, not uncommon; may occasionally breed in the state," is definitely referred to in the "History of the Birds of Kansas" as a rare resident and common migrant.

Colonel Goss recorded in the catalogue the occurrence of the Anhinga, *Anhinga anhinga*, in the state, a single specimen having been taken in August,

*NOTE.—*Phalœnoptilus nuttalli nitidus*, Brewst., is an addition to the list and occurs simultaneously with *Phalœnoptilus nuttalli*, which is after all the more common form in Kansas.—D. E. LANTZ.

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1881, in the Solomon valley. In the Trans. Kan. Acad. Sci., Vol. XI, p. 58, 1889, he reports the shooting of five of these birds on May 1, 1888, in Meade county.

The Ruddy Duck, *Erismatura rubida*, entered in the catalogue as migratory, is listed in the "History of the Birds of Kansas" as a rare summer resident and common migrant.

On October 17, 1890, a young female White-faced Glossy Ibis, *Plegadis guarauna* (Linn.), was shot on the Arkansas river by Dr. R. Matthews and sent to Colonel Goss for identification. This is the second occurrence of the bird in the state. A third specimen was taken out of a flock of 20 on a pond near McPherson, April 29, 1891.

Wilson's Phalarope, *Phalaropus tricolor*, entered in the catalogue as a common migrant, was, on June 18, 1886, found by Colonel Goss breeding on marshy ground bordering a pond in Meade county. The bird should be listed, therefore, as an occasional summer resident in western Kansas, and a common migrant throughout the state.

On April 23, 1893, Mr. H. W. Menke shot a Lewis's Woodpecker, *Melanerpes torquatus*, in Finney county, this being the second reported occurrence of the species within the state. The Piñon Jay, *Cyanocephalus cyanocephalus*, entered in the catalogue on a single occurrence at Lawrence, reported by Prof. F. H. Snow, is reported by Mr. Menke as having been a common winter resident in Finney county up to 1891, appearing in large flocks in the autumn of 1889, 1890, and 1891.

Colonel Goss, in the Trans. Kan. Acad. Sci., Vol. XII, p. 60, 1890, says that he is satisfied that the evidence upon which his catalogue entry regarding the breeding of the Sycamore Warbler, *Dendroica domenica albilora*, in the state, is not reliable. He adds, however, that he has upon several occasions met the birds in the state during the summer months.

ADDITIONS TO THE LIST OF KANSAS COLEOPTERA.

By WARREN KNAUS, McPherson, Kan. Read (by title) before the Academy January 4, 1896.

For a number of years comparatively little systematic and careful collecting has been done in the state, with the view of adding to the already long list of Kansas beetles. The various lists of Kansas Coleoptera, as published in the proceedings of this society, need revision badly. The entire material in the various collections should be gone over, identifications verified, and the list brought up to date in conformity with the advance made in this division of entomology. The truth of the above is illustrated by the genus *Lachnosterna*, the material of which in Kansas collections has been recently worked over and a surprisingly large number of species new to the Kansas list identified. That the present list of over twenty-one hundred species and their varieties can be largely increased, no one will question who is a worker in Coleoptera. Persistent and intelligent collection of the smaller forms will add scores of species new to the Kansas list, and many species not now described. Such collecting should be especially successful in southeastern and northeastern Kansas, and in a lesser degree in southwestern and northwestern Kansas.

The following species not heretofore catalogued as belonging to Kansas have been taken since 1887, or identified in the collections of the State Agricultural College and State University. Identifications have been made and verified by

M. L. Linell, E. A. Schwarz, and Thomas L. Casey, of Washington, D. C.; J. B. Smith, of New Brunswick, N. J.; and Charles Liebeck, of Philadelphia, Pa. The identifications in the Agricultural College collection have been made by Assistant Entomologist F. A. Marlatt, and in the State University by Entomologist Hugo Kahl, to all of whom many thanks are due.

The numbers are those of Henshaw's list and the third supplement thereto.

682. Amara subanea, Lec. Taken at McPherson, Kan., at electric lights. June, July.

734. Badister maculatus, Lec. Taken at McPherson, Kan., one specimen in electric lights. June.

774*b*. Platynus texanus, Lec. McPherson, electric lights. May and June.

9684. Bledius ineptus, Casey. Taken in Kansas, near Superior, Neb., in May and June; occurs burrowing in sandy mud along sand-bars in Republican river.

3110. Hyperaspis signata, Oliv. Benedict, Kan. April, two specimens.

3315. Pediacus depressus, Hbst. Verdigris river, north of Benedict, Wilson county, Kansas.

3625. Saprinus patruelis, Lec. Kansas, near Superior, Neb. May.

3683. Carpophilus antiquus, Melsh. Salina, Kan.

3688. Colastus unicolor, Say. Wilson county, April, feeding on sap from elm stump.

3734. Pocadius helvolus, Er. Taken with 3688.

3739. Meligethes mutatus, Harr. Kansas, near Superior, Neb. May.

3870. Bactridium striatum, Lec. Same date and locality as 3688.

—— Limnichus sp. Reno county. May.

5334. Ptilinus thoracicus, Rand. Kansas, near Superior, Neb. May.

5425. Canthon nigricornis, Say. Taken on sand-dunes, near Medora, Reno county. May.

5682. Serica curvata, Lec. Same time and locality as 5425.

5730. Piplotaxis corvina, Lec. One specimen, Wallace county. July.

10229. Lachnosterna hamata, Horn. Rare, taken May and June. In Wilson and Douglas counties.

10230. Lachnosterna generosa, Horn. Not common. May and June. Wilson county.

5749. Lachnosterna ephilida, Say. Not common. Specimen from Wilson county and in the University collection from Salina. July.

10233. Lachnosterna hirtiventris, Horn. Not common. Wilson and Douglas counties. May.

5762. Lachnosterna subpruinosa, Casey. Rare. Agricultural College collection.

5759. Lachnosterna errans, Lec. Agricultural College collection.

10235. Lachnosterna inversa, Horn. Rare. Agricultural College collection.

10236. Lachnosterna bipartita, Horn. Not common. Wilson county, McPherson, and Manhattan. May.

10237. Lachnosterna vehemans, Horn. Not common. Wilson and Douglas counties. Manhattan. April.

10238. Lachnosterna arcuata, Smith. One specimen, Medora, Reno county. May.

10240. Lachnosterna dubia, Smith. Rare. McPherson. May.

10241. Lachnosterna grandis, Smith. Rare. Wilson county. May.

10242. Lachnosterna ulkei, Smith. Rare. Salina. May.

10246. Lachnosterna spreta, Horn. Four specimens. McPherson. May.

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10248. Lachnosterna infidelis, Horn. Not common. Wilson county and McPherson. May.
10252. Lachnosterna hornii, Smith. Rare. Wilson county. May.
10253. Lachnosterna biimpressa, Smith. Rare. Specimen in National Museum. Locality Manhattan.
5776. Lachnosterna Knochii, Gyll. Common. Salina and McPherson. May. This species is usually mistaken for the more common rugosa.
10228. Lachnosterna diffinis, Blanch. = rufiola Lec. University collection.
10255. Lachnosterna implicita, Horn. Rare. Wilson county and Agricultural College collection. May.
5782. Lachnosterna balia, Horn. Rare. Agricultural College collection.
—— Lachnosterna minor, Linell. New species, described from a single male specimen in pamphlet No. 1096, Proc. U. S. Nat'l Museum, Vol. XVIII. Collected by F. F. Crevecoeur, Onaga, Kan.
5790. Lachnosterna albina, Burm. Rare. Agricultural College collection.
5791. Lachnosterna parvidens, Lec. Rare. Agricultural College collection.
10266. Lachnosterna affabilis, Horn. Rare. Two males in collection of Dr. Horn; also in Agricultural College collection.
10277. Stephanucha pilipennis, Kraatz. Medora, Reno county, Kansas. May. Taken on sand-dunes.
6209. Microclytus gazellula, Hald. Wilson county. June.
10428. Crepidodera longula, Horn. Taken on willow, in June and July, in Osage and Wilson counties.
6871. Luperus brunneus, Cr. Wilson county. June.
—— Blapstinus sp. Medora. May.
7433. Blapstinus dilatatus, Lec. Taken in sand blow-outs near Medora. May.
7442. Blapstinus moestus, Melsh. Same as 7433.
7460. Ammodonus fossor, Lec. Taken at Medora, Kan., in sand. May.
7531. Hypophloeus cavus, Lec. Taken under hickory bark. Verdigris valley, north of Benedict.
8365. Apion robustum, Smith. Salina, Kan., on sunflower.
8373. Apion sordidum, Smith. Salina, Kan., on sunflower.
8412. Apion griseum, Smith. Salina, Kan., on sunflower.
8420. Apion attenuatum, Smith. Salina, Kan., on sunflower.
—— Apion occidentale, Fall, Mss. Salina, Kan., on sunflower.
—— Apion spinipes, Fall, Mss. Kansas, near Superior, Neb. May. Rare.
—— Nebraskense, Fall, Mss. Kansas, near Superior, Neb. May. Rare.
11115. Baris exigua, Casey. Kansas, near Superior, Neb. May.
—— Rhyncholus sp. Larva burrows in decaying cottonwood; beetles emerge in May and June. Can be taken in winter in larval burrows. Two other species occur with this, but none are described.

THE DRILL HOLE AT WICHITA.

By J. R. MEAD, Wichita, Kan. Read before the Academy January 3, 1896.

In the year 1895, the city of Wichita voted $10,000 in bonds to drill one or more holes to ascertain what of value might be found beneath the city. Coal, salt, oil and gas were among the possibilities.

A sample of each five feet in depth has been preserved in glass jars properly numbered. The hole is within the city limits, in the valley of the Arkansas, one-

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fourth of a mile from the river and within 50 feet of the track of the Missouri Pacific railroad. Work commenced October 20, 1895.

The first 12 feet was through surface soil and clay. Strata of quicksand and gravel filled with water were then reached. This constituted the underflow or "subterranean river," as it was called in the newspapers. Great difficulty was experienced in securing a curbing through this sand and water, which caused a delay of several weeks. First, a round wooden pipe, 16 inches in diameter, strongly made of two-inch pine and wrapped with sheet iron, was placed in the hole and gradually sunk by pumping the sand from the inside. As depth was gained the pipe constantly bent to the southeast, indicating a pressure in that direction. Trains passing imparted a quivering motion to the sand and water. The wooden pipe was abandoned, as it could not be kept vertical. A heavy wrought-iron tube 14 inches in diameter was substituted, which proved a success.

Following is a log of the well, which at this writing has reached the first hard rock, black flint or chert, at a depth of 642 feet:

LOG OF THE WELL.

Depth, feet.	*Thickness, feet.*	
12	12	Surface soil and clay.
27	15	Quicksand and water.
42	15	Coarse sand and gravel, full of water.
80	38	Tenacious blue clay.
90	10	Gypsum crystals (selenite). Between 80 and 90 feet a pocket of smooth water-worn pebbles, consisting of white quartz, quartzite, granite, jasper, etc., broke into the well from the side.
165	75	Alternating layers of clay, gypsum, and clay shales.
250	85	Massive gypsum, gray and black.
265	15	Blue shale.
270	5	Gypsum.
275	5	Light and dark shale.
285	10	Soft clay shale.
295	10	Clay and gypsum.
300	5	Gypsum.
325	25	Blue shale.
350	25	Black shale.
375	25	Blue shale.
385	10	Dark shale.
390	5	Blue shale.
400	10	Black shale.
440	40	Blue shale.
455	15	White and gray gypsum.
480	25	Shale, strongly charged with petroleum.
490	10	Dark shale.
550	60	Light gray shale.
560	10	Gray limestone.
563	3	Fine sand full of very strong brine which rose 300 feet in the drill hole, and would perhaps have risen to the surface had it not been stopped by the insertion of tubing.
572	9	Gray limestone and clay.
575	3	Clay shale.
585	10	Black shale.
590	5	Blue clay.
600	10	Soapstone and clay or shale.

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Depth, feet.	*Thickness, feet.*	
610	10	Light gray limestone.
615	5	Dark soapstone.
630	15	Dark shale.
637	7	Gray limestone.
642	5	Black flint (chert).

"CONE-IN-CONE" (AN IMPURE CALCITE).

By H. J. HARNLY, McPherson, Kan. Read before the Academy January 3, 1896.

I have been unable to determine who first named this peculiar variety of impure calcite "cone-in-cone." The name has apparently grown out of its peculiar structure, for "cone-in-cone" in fact it seems to be.

My attention was first called to the mineral about three years ago. Some took it to be fossil wood, which in some respects it resembles; others boring through it in well-making took it for a bed of bones, while still others supposed it to be a distinctive mineral, possibly new. During the summer of 1893 I found it in place in various localities in the northwestern part of McPherson county and the southeastern part of Ellsworth county. It is reported to be found in Lincoln and Russell counties. During the past summer I found it in two localities in Washington county.

In McPherson and Ellsworth counties, where I have seen it in place in many localities, it is found always to occupy the same relative position, underlying the Dakota sandstone and clay, and overlying a bed of shells which varies from a fraction of an inch to two or three inches in thickness. Underlying the bed of shells there is a stratum of clay of considerable thickness, and rich in gypsum crystals. I have found in it almost perfect individual crystals seven inches long. Beneath the clay there is red shale.

The cone-in-cone varies from less than an inch to six or seven inches in thickness. In Washington county it immediately underlies the Fort Benton limestone.

Being desirous to know more definitely what the substance is, I had several analyses made of it. They all agree in making it a calcite with some SiO_2, Fe_2O_3, Al_2O_3, as impurities; the purer specimens giving the regular calcite analysis with but slight impurities. The following are the results of the analyses:

SiO_2 from 1.4 to 5.84 per cent.
Fe_2O_3 and Al_2O_3 from 1.2 to 2.62 per cent.
CaO from 54.13 to 54.64 per cent.
CO_2 from 33.07 to 42.06 per cent.
MgO from .0 to 2.76 per cent.
and traces of several other compounds.

No fossils were found in the cone-in-cone itself. It seems evident that it was deposited from a water solution, probably at the time when the seas were drying up, so that the water became saturated and the animal life destroyed. The peculiar almost constant cone structure is harder to explain, but most probably is due to the impurities.

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THE CLOSING OF MICHIGAN GLACIAL LAKES.

By B. B. SMYTH, Topeka. Read before Academy January 3, 1896.

Livingston county, Michigan, is near the center of the state; and while its elevation is not great above the lakes, yet it is about the highest land in central Michigan. The waters from it run northward into Lake Huron, westward into Lake Michigan, and southeastward into Lake Erie.

There is very little native rock exposed in the county; there is a heavy mantle of drift nearly all over the county, in many places exceeding 100 feet in depth. This drift varies in its nature in different parts of the county: in some places it consists largely of clay thickly interspersed with rounded pebbles and boulders from four inches to perhaps two feet in diameter; in other places the drift consists largely of gravel and water-worn pebbles to a depth of 20 to 40 feet, and again it consists of sand and clay heaped up into what is known as "short hills," often to a height of more than 100 feet. Moraines of stone are frequent, and nearly always run due east and west, occasionally varying to south of east and north of west.

Those high hills and drift lands are by no means the barren lands one might be led to suppose. Much of the drift is mixed with a large proportion of lime, or limestones, carried from hills not very far remote; and the presence of stones on the surface seems to have a tendency to warm the soil and hasten the growth of crops.

On many farms the stones are so thick on the surface that it is impossible to plow without removing the larger part of the stones to a depth that will permit plowing. These stones, although they entail much labor on the farmer, are a source of wealth after all; they furnish material for all the fences needed, besides houses and other buildings. Allow me to describe one, that of Mr. Riddle, of Osceola township, which is representative of a great many of the wealthier farms of the county, especially of that township.

DRIFT PEBBLES.

Miles of stone fence, four feet high, are to be seen. Some of these fences, especially those running alongside the main road, are built with an eye to artistic beauty. The base consists of a layer of heavy, rounded, gray granitoid stones; then follow a couple of layers of smaller water-worn pebbles of nearly uniform size and about 10 inches in diameter; then a layer of heavy red quartzite about 10 inches in thickness; then again several layers of white rounded pebbles, finally capped with a layer of broad greenstone schist and blue limestone. Barn and other buildings are built of the same kinds of stone.

The house, which is quite a roomy one, is built almost entirely of ovoid pebbles about 5 by 8 inches in diameter and 11 inches in length. These pebbles are very uniform in size and laid up in the cementing material in herring-bone style: First, on a solid foundation of quartzite or granitoid boulders, a horizontal row, nearly on end, slanting upward to the right, next a row slanting upward to the left, and so on alternately, making the pebbles stand in zigzag fashion. An occasional binding layer of larger boulders of a different color is put in, the upper layer being especially heavy. The corners and door and window posts are of larger stones of different color laid flatwise; the lintels are of greenstone trimmed. The house has the appearance of having been quite recently built, but an inquiry

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disclosed the fact that it had been built 18 years before. The cementing material in which these stones were laid must have been of an exceedingly good quality, and the builders must have perfectly understood the art of laying them up in that unique fashion. Except upon the sills and lintels no mark of tool other than that of trowel upon the mortar was noticeable upon the walls. Indeed these pebbles are so hard as to almost defy any tool to work them into shape.

My object in describing such buildings and fences is not merely to show the thrift of the people, but to show the abundance of the drift material, where selections of so many stones, uniform in size, color, and shape, may be made.

Lakes and Marshes.

Nearly everywhere, in the hollows among these drift hills and on the low grounds where the hills do not exist, there are small lakes and numerous marshes. The marshes have the appearance of having at one time been lakes. Sometimes the marshes are mere circular belts of marsh surrounding small lakes that are continually growing smaller and smaller. In a few places the marshes have entirely overgrown the small lakes; and near the middle, where they have not become entirely solid, a pole 20 feet long may be pushed down through the marsh into the underlying lake, which has not yet filled up below; in other places where the lake is not yet closed, the edge of the marsh extends out over the lake quite thinly, and in such a way as to overhang the water, often to a considerable distance. By standing on the ground in one spot, and dancing lightly, the surface all around for some little distance may be made to vibrate; and if one were to continue the dancing or vibratory movement he would sink into the soft black muck entirely out of sight. Cows and horses often sink so they are unable to extricate themselves. They are then said to be "mired."

Not all lakes have marshes surrounding them. Sand-bottomed lakes are not surrounded by marshes, but the water washes the clean hard shore; mud lakes too are seldom surrounded by marshes; but the lakes, whose bottoms are composed of a hard impervious clay, and which have, as nearly all lakes have, small sluggish outlets, are almost invariably surrounded by marsh. Marshes that have grown over shallow lakes have rapidly covered the entire lake and have caused the lake to disappear. The growth of marsh over the edge of deeper lakes, those reaching to a depth of 15 feet and upward, is very slow; and on a lake with a depth of 30 feet the marsh around its edge is scarcely seen to make any progress.

A recent visit to the home of my childhood has shown me what appears to be a surprising reduction in the size of those lakes. Naturally, a 30 years' absence would make the lakes appear very much smaller; but that it is not all a personal difference may be readily seen when the structure of those marshes is taken into account. The tall grass growing on the edge of the marsh next to the water, when it decays, largely overhangs the edge into the water, where it is held in place by the growing rootlets of the grass, until, after the lapse of many years, a perceptible thickness must be added to the extending edge of the marsh. The growth and extension of marsh is more rapid than the wear of the edge by the wash of the waves, which is scarcely anything. Again, the growth of pond-lilies and other water plants in the shallows rapidly hastens the extension of marsh and the closing of the lakes by allowing a slight deposit on their floating leaves, to be followed by an interwoven mass of vegetation which permits the accumulation of vegetable mold and humus. Extension of marsh under such conditions is many times more rapid than where the water is deep. Extension of marsh over a deep lake may be estimated at one thirty-second to one-twelfth of an inch annually. This would equal a growth of one foot horizontally toward the center

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of the lake in 150 to 400 years. The narrowest marsh I have seen around a little lake 30 feet or upward in depth is about 150 feet in breadth; and if 7,000 years be taken as its probable duration, since the disappearance of the permanent ice, the lowest estimate would be about right. On the other hand, lakes one-half to one mile in extent and not over six feet deep have been entirely overgrown by marsh and are dried up.

The thickness of the black vegetable stratum that covers any marsh varies, according to the depth of the original lake, from 2 to 10 or 12 or even 20 feet, where the lake is very deep. It takes a very long time for a thickness of two feet or more to form by the decay of the grasses and other marsh plants that grow there. After the marsh becomes firmly fixed to the ground, tamarack trees grow, and it becomes a swamp.

Underneath the overhanging marshy covering at the edge of any lake may be found a certain depth of infusorial or calcareous earth. This forms around the edge of all marsh lakes. It does not keep pace in its growth with the growth of the marsh; and if the edge of the lake where the shells may be found should be moderately deep, the shells are constantly falling through the ooze to the bottom, leaving the upper portion next to the marshy covering very thin and loose; yet the growth of marsh surface continues, and when the lake is not deep its extension toward the center is reasonably rapid.

A Marsh Lake.

A description of one of these lakes in this connection will be appropriate, as it is representative of a large class of very small lakes, all of which come under the rule as to closing: A small deep lake in the edge of the "short hills" and close to the great Shiawassee marsh hereafter described. It is known as Drew's lake, and is nearly surrounded by hills 25 to 40 feet high. The lake is nearly circular; diameter about 400 feet from marsh edge to marsh edge; depth at edge of marsh 15 to 18 feet; depth in middle of lake about 30 feet. The water is quite clear, though slightly reddened as though it were a weak infusion of grass, tamarack, and other leaves. There is no permanent inlet; there is a small sluggish outlet discharging about one-half cubic foot per second. Outlet is bordered by marsh land.

Completely surrounding the lake is an annulus of marsh land 50 to 75 feet wide, covered with marsh grasses and sedges, with a few other marsh plants interspersed. Most of the surface of the marsh is one or two inches above the level of the water; though there are spots one or two inches below the surface of the water. Such spots are covered exclusively with a small species of *Eleocharis* (possibly *E. tenuis*), perhaps several species.

Near the outlet and at one other spot which approximates a temporary inlet, there are boggy tracts in which the grass grows only on the tops of "bogs." These "bogs" are tufts of peat about 8 to 12 inches across and 10 inches high, broadest at the top, and 4 to 10 inches apart. They are level on top and uniform in height, with perpendicular or concave sides. Water flows sluggishly at times in the interstices between the bogs. There is no vegetation between the bogs, except in the drier places a little sphagnum.

The marsh floats. Thickness at its edge about 30 inches; depth of underlying water about 14 feet; one or two feet deeper in high water. Thickness or depth of marsh 50 feet back from the edge, 6 feet; depth of underlying ooze about 8 feet. Measurements were taken with a smooth, sharp-pointed tamarack pole. The relative depths of humus and underlying ooze could only be determined by the difficulty of pushing the pole down. As soon as the peaty stratum was penetrated the pole would go down easily. The pole brought up adhering to

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its point a few small gastropods and other minute shells. The ooze underlying the peat consists mostly of minute particles of humus, having a specific gravity of 1.016, hence resting but very lightly at the bottom. The shells of dead diatoms, with a small admixture of minute gastropods which at one time lived at the surface of the marsh, having greater specific gravity, fall through to the bottom and form a white stratum several inches in thickness in the course of time. This stratum is removed by the wagon load from dried marshes and spread over lands as a fertilizer for wheat. It is locally called "marl." I do not know its value.

For the first 25 feet surrounding the lake the marsh is a perfect morass, quite dangerous to walk upon, though it may be done; for the next 25 feet it is reasonably safe. It is all unsafe for cattle. This portion of the marsh is sprinkled with the common pitcher plant, *Sarracenia purpurea.*

Immediately surrounding this first annulus is an annulus 10 to 25 feet wide, covered with the same species of marsh grasses and plentifully with *Cassandra calyculata*, *Andromeda polifolia*, and *Kalmia glauca.*

Next outside of this is an annulus about 15 feet wide, covered almost exclusively with small tamarack trees 3 to 15 feet high. Here the marsh rests upon the solid ground.

The next annulus surrounding the lake is covered with full-grown tamarack trees. The width of this ring is 40 to 50 feet, widening to more than double that in a pocket between the hills. This strip, although a few inches higher than the grassy marsh inside, is usually covered with several inches of water, and is known as "swamp." There is a slight admixture of clay with the peat here, being carried from the neighboring hills. The peat here is composed of sphagnum instead of grass, as in the marsh inside. The sphagnum grows plentifully here between the roots and knees of the tamarack trees.

Outside of the tamaracks, next to the hills, there is an interrupted strip of black ash swamp, varying from nothing to 50 or 60 feet in width in the pocket between the hills. Here there are a few red birch trees, with here and there an occasional high-bush cranberry (*Viburnum opulus*) and clump of high-bush huckleberry (*Vaccinium ovalifolium*). In this part of the swamp the wash from the neighboring hills has accumulated somewhat, so that it is almost dry except in freshets. Outside of this there are cultivated fields.

Marl.

I hold in my hand some samples of marl taken from a marsh at the head of the Shiawassee river, in which the lake has entirely disappeared. The marsh is many miles in length; its width at the place observed is nearly half a mile and its depth in the center is about seven feet. Recently a large ditch has been dug lengthwise through the marsh, cutting down to the clay foundation. Lateral ditches have been dug by the people from the side of the marsh to the main ditch. Measurements of the depth in one of these laterals, down to the blue clay substratum, are as follow: Near outside edge of the marsh, thickness of the black muck, 18 inches; underlying white marl, 5 inches; half way between edge of the marsh and the big ditch, thickness of the muck, 34 inches; underlying marl, 10 inches; thickness near the center of the marsh, of the muck, 4½ feet; underlying marl, 32 inches. The muck would probably have been deeper, but that at about the time of disappearance of the lake there was deepened drainage, causing the center of the marsh to settle down into a dishing shape, leaving the outer portion flat, as are all Michigan marshes.

These three samples of marl were taken from the three localities mentioned as

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having been measured. No. 1, from the edge of the marsh, represents the most ancient period; No. 3, from the middle of the marsh, the most recent.

To sum up: First, all Michigan lakes are disappearing, not by drainage or evaporation altogether, but by being converted into bogs or marshes. Many shallow lakes are already closed in that manner; all others are closing. Second, deposits in those lakes do not succeed each other from the bottom upward, but from the sides centerward. A find resting on the clay four feet below the surface near the edge of a marsh or ancient lake may represent a time vastly anterior to a find similarly situated 20 feet below the surface near the center of the same marsh.

Another closing observation: Additions of growth in a marsh are not made entirely by horizontal deposits of foliage, but largely by perpendicular additions of grass roots throughout the extent of the newly forming marsh and by perpendicular additions of grass leaves overhanging the edge next the lake. Pressure is mostly horizontal and from the center of the lake toward its periphery by the swelling of the ice in the lake in winter. This aids in making the material constantly more compact after being once formed. It aids also in thickening the deposit by reducing the surface dimensions.

THE STRATIGRAPHY OF SHAWNEE COUNTY.

By J. W. Beede, Topeka, Kan. Read before the Academy January 4, 1896.

There are good exposures of the Upper Coal Measures, and especially of the highest Carboniferous coal-beds of workable thickness in the state, in Shawnee county. The best sections are the bluffs on the south side of the Kansas river. The first students of this section of Kansas geology were Meek and Hayden in 1858, and Prof. G. C. Swallow in 1865. Prof. O. St. John published the results of his work in 1881 and 1882. Later Prof. Charles S. Prosser and Prof. E. Haworth contributed to the knowledge of the region.

General Description.

There are about 550 feet of the Upper Coal Measures strata exposed, ranging from about 1,875 to 2,425 feet above the base of the Coal Measures.* The strata are a succession of limestones, shales, and coal. They dip to the west about 10 feet to the mile. There are no faults or folds of any consequence. The highest stratum of coal found in paying quantity in the eastern half of the state traverses the county in a northerly direction, passing through the central part.

The topography is comparatively simple. The Kansas river crosses the county from west to east, with a broad valley situated largely on the north side of the river. North of the river bottom is a rolling prairie, which rises to an elevation of about 1,100 feet A. T. at the north line of the county. A prairie extends from the south bluff of the river to a high divide, which traverses the county a little south of west, being intercepted for a few miles near Pauline. This divide reaches its highest point in the southwest corner of the county, where it is 1,200 feet A. T.† In the southern part of the county lies the broad valley of Wakarusa creek, which is nearly as low as the river bottom itself. Three heavy limestone systems give the more rugged topography to the county.

While we do not enter into the discussion of the subject in this paper, it may

* See Prof. E. Haworth, Kan. Univ. Quar., Vol. III, No. 4, April, 1895.

† U. S. topographic sheets.

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be well to mention a few facts concerning the glacial geology of the county. Although the general trend of the terminal moraine is northwest and southeast, this is but very roughly true of the part which lies in Shawnee county. Entering the county a little north of Richland, it extends in a northwesterly direction towards Topeka, passes around the north side of Burnett's Mound (three miles southwest of Topeka), thence a little westward, where it bears to the southward to within a mile of Dover and crosses the west line of the county. The break in the divide at Pauline, which is fully a hundred feet in depth at that place, formed an outlet to the water at the foot of the glacier.*

Historical.

Meek and Hayden.—In 1858, Messrs. Messrs. F. B. Meek and F. V. Hayden crossed Shawnee county on their "Geological Explorations in Kansas Territory." † In this preliminary tour, one or possibly two sections were made in this county. The most important section was made near the old Baptist Mission. Here a section of 164 feet is given in detail. The place was probably near the place where the Topeka sugar works are now situated. The other section was one of 12 feet, somewhere southwest of Grasshopper creek.

Swallow.—Later Prof. G. C. Swallow, in his "Section of the Rocks of Eastern Kansas," ‡ gives a section of the rocks of eastern Kansas which crosses Shawnee county from west to east. The structure is given in detail, but contains several errors. He gives 32 strata, which are probably supposed to be contained within the county. This includes sandstone and shale strata, which change from one to the other, and can hardly be separated with any degree of distinctness.

St. John.—Prof. O. St. John, in his article on the "Geology of Kansas," § gives a clear description of the Kansas Coal Measures and correlates the Topeka coal with that of Burlingame and Osage City.

Prosser.—Prof. Charles S. Prosser has recently done some work for the U. S. Geological Survey which extends into the county and is of considerable interest. He divides the upper part of the Upper Coal Measures ¶ and Permian of eastern Kansas into formations, the lowest of which is the "Wabaunsee." The shale overlying the Osage City coal is the base of this formation.

Haworth.—In an article entitled "The Stratigraphy of the Kansas Coal Measures," ¶ Prof. E. Haworth gives the stratigraphy of the state in ascending order. Shawnee county is included in the section, and consequently its strata are correlated with those of the rest of the state.

Stratigraphy.

1. Tecumseh Shales.** — Beginning at the east line of the county and taking the strata in ascending order, is a series of shales of about 75 feet in thickness found east of Tecumseh and in the vicinity of Richland. These shales are nearly non-fossiliferous, of fine texture, containing many ferruginous concretions, and occasional strata of soft, shaly sandstone. They are somewhat of an olive color.

2. Calhoun Limestone.—Three strata of limestone, bluish to yellowish gray

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* Mr. B. B. Smyth discusses this subject in Vol. xiv, Transactions of this Academy, pp. 220-226.

† Proc. Acad. Nat. Sci., Phila., 1859, pp. 8-30.

‡ Prelim. Rep. Geol. Sur. Kan., 1868, pp. 1-28.

§ Third Biennial Rep. State Board Agriculture, Kansas, 1881-'82, pp. 571-579.
Bull. Geol. Soc. Am., Vol. vi, pp. 29-54; also, Jour. Geol., Vol. iii, pp. 682-705, 764-800.

¶ Kan. Univ. Quar., Vol. iii, No. 4, April 1, 1895.

** These names are simply local references to the particular strata for convenience of students in this county, and no other importance should be attached to them.

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in color, separated by layers of shale. The total thickness is 15 to 20 feet. The principal stratum is the uppermost, which varies from 7 to 10 feet in thickness. It is a massive limestone, in color light gray tinged with yellow. The texture may vary considerably in a short distance. The typical exposures are at Calhoun Bluffs, about three miles northeast of Topeka, where the Union Pacific railroad cuts the bluff of the Kansas river, and just east of Tevis, and on the bluffs north of Richland. It also appears on Muddy creek. It is hard and quite fossiliferous. It has been quarried for paving stone, the quarry being situated north of the road where Sixth street crosses Deer creek.

3. CALHOUN SANDSTONE AND SHALE.—This stratum is 50 to 65 feet in thickness. The lower part of the stratum is a layer of soft, argillaceous sandstone from 12 to 20 feet thick. This is perhaps the most persistent sandstone in the county. The shale is of bluish tint and comparatively fine texture. The location of this stratum is the same as the preceding, except that it ranges a trifle further west.

4. TOPEKA LIMESTONE (Haworth).*—This system of limestone is 10 to 15 feet in thickness, according to the thickness of the clay partings, composed of four strata separated by partings of clay-like shale. This system forms a marked feature in the topography of the eastern part of the county. Typical exposure at the county quarry in the fair grounds, at Topeka; but here only the three lower strata are exposed. It rises in a southeasterly direction to the east line of the county, forming the tops of the high hills southeast of Tecumseh. It is exposed at Wakarusa station, and forms the top of the escarpment at Calhoun Bluffs. This limestone has been quarried more than any other in the county, and is used to a considerable extent for building purposes. It is a light buff in color, except the lowest layer, which is of a bluish gray tint. It contains considerable chert.

5. OSAGE CITY SHALES (Haworth).*—This is a stratum of bluish varying to a yellowish shale, 50 feet in thickness, very argillaceous and nearly barren of fossils. Typical exposure, Topeka vitrified brick works, one-half mile west of insane asylum. It is the shale used by the above company in the manufacture of the walk and paving brick in Topeka. The brick is of very high grade of hardness, and is the finest produced in this country for paving purposes.

6. OSAGE COAL.—This coal is variously called the "Osage," "Burlingame," "Scranton," "Carbondale," "Topeka," etc., coal. It is correlated by Professor St. John† as the Osage Coal. It is a stratum of bituminous coal from 6 to 20 inches in thickness. It is mined three miles southwest of Topeka and from Martin's hill to within a mile and a half of Washburn College, and also at Burnett's mound. It appears near Pauline, where it is about six inches thick; while on Wakarusa creek, west of Wakarusa station, it seems to be entirely wanting, or the shale above it thickened to four or five times its usual thickness in this county. On the north side of the Kansas river it is to be found on the Halfday and Indian creeks and also near Meriden and Valley Falls.

7. SHUNGANUNGA SHALE.—Base of the "Wabaunsee" formation of Professor Prosser. This stratum of shale varies from 10 inches to 10 feet in thickness and in color from a dark olive to a bluis ‡ and even jet black. It is very fossiliferous in places. Localities same as previous stratum. Eastern extremity of this formation indicated on the plate by the line between the shaded and unshaded portions. The shaded portion is the Wabaunsee formation.

*These names are simply local references to the particular strata for convenience of students in this county, and no other importance should be attached to them.

†Ibid. See, also, Univ. Geol. Surv. Kan., Vol. I, p. 161, and foot-note.

‡Third Biennial Report Kansas State Board Agriculture, 1881-'82, p. 585.

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8. Spring Rock (Swallow).*—Here we have two strata of limestone separated by a layer of shale. Of these the lower is the more important, the upper being as a rule very thin and somewhat argillaceous. The lower is about 20 inches thick, hard, bluish gray in color, often containing calcite crystals, and is susceptible of a high polish. It has been quarried for paving purposes, and is the hardest limestone in the county. This stratum has, so far, produced a larger number of species of fossils than any other stratum in the county. Localities same as two previous strata.

9. Burlingame Shales (Haworth).†—Olive shales, generally very argillaceous, though arenaceous in places, 120 feet thick, and the most extensive shale bed in the county. The stratum is very fossiliferous in places, and barren of fossils in others. It is exposed at the Sugar Works, on the lower part of Blacksmith and Mission creeks, southeast of Auburn on Wakarusa creek, on the north side of the river from near Siver Lake, crossing the county in a direction east of north.

10. Silver Lake Coal.—A bituminous coal 4 to 16 inches thick. This is the highest stratum of coal found in paying quantity in the Coal Measures in the state. It is mined at the Croasdale place, 10 miles southwest of Topeka, and has been mined at the Sugar Works, Silver Lake (Pence's farm), and some further northeast, and is reported from the Pottawatomie reservation, and northwest of Meriden.

11. Silver Lake Shale.—This shale, which is olive in color and not very rich in fossils, is 15 to 35 feet in thickness, and contains a thin, very argillaceous limestone.

12. Stanton Limestone (Swallow).‡—This limestone is composed of two layers, separated by a thin parting of shale. The lower is the more important. It is from four to seven feet in thickness, massive, yellowish gray to gray, and almost non-fossiliferous. It resists the weather very well, and is easily traced across the county, as it often forms the top of high escarpments. It is exposed on Wakarusa creek, near Auburn; on Mission creek, from a place west of Burnett's mound to the Kansas river; at Burnett's mound, Martin's hill, and the sugar works; from Silver Lake up Big and Little Soldier creeks about three miles, thence in an easterly direction. It appears at Elmont and crosses the county line nearly north of that place.

13. Soldier Creek Shale.—This shale is from 40 feet to less in thickness, quite arenaceous, and moderately fossiliferous in places. Localities same as the preceding.

14. Wakarusa Limestone.—A limestone two to four feet in thickness, very fossilferous, and a fine building stone. Localities practically the same as the two preceding. Named from the fine exposure of this rock on Wakarusa creek immediately south of Auburn.

15. Auburn Shale.—This is a stratum of shale 8 to 20 feet in thickness, olive in color, and quite fossiliferous. Localities practically the same as the preceding.

16. Elmont Limestone.—A stratum of white or gray argillaceous limestone, very fossiliferous, from one to two feet in thickness. It is used in stone walls in some places. It is found on the tops of the hills near Elmont and north into Jackson county; also on both sides of Big and Little Soldier creeks, from the

* Prelim. Rep. Geol. Surv. Kan., 1868, p. 21, "No. 162."
† Univ. Geol. Surv. Kan., Vol. I, p. 162.
‡ Prelim. Rep. Geol. Surv. Kan., 1868, p. 20.

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Kansas river up Blacksmith and Mission creeks two-thirds the way to Dover, and at Auburn.

17. WILLARD SHALE.—This shale is 55 feet thick, and is exposed down Big and Little Soldier creeks from Jackson county to the Kansas river, and from the Kansas river to Dover; also southwest of Auburn and southwest of Burnett's Mound.

18. CHOCOLATE LIMESTONE (Swallow).*—A limestone 7 to 10 feet thick, chocolate brown, sometimes lighter, and containing great quantities of *Fusilina cylindrica* Fischer. This is the most easily recognized limestone in the county, often forming escarpments 50 to 100 feet high. It withstands weathering remarkably well, and is used quite extensively for stone walls. It would probably prove valuable as a building stone. It appears on the top of the hill at Auburn and to the southwest; also from Dover to the Kansas river, and from the Kansas river up the two Soldier creeks to Jackson county. It also appears along the base of the hills that border the Kansas bottom a few miles west of Rossville.

19. DOVER SHALE AND SANDSTONE.—This shale is 85 feet in thickness, very arenaceous in texture, varying in color from a light yellow to a deep brownish red, containing much argillaceous sandstone which is exposed on the road east of Dover. It is nearly non-fossiliferous. It appears near Dover and southwest, and in the northwest part of the county.

20. DOVER LIMESTONE.—This limestone is four feet to less in thickness, appearing near Dover and to the southwest, and in the northwestern portion of the county.

21. ROSSVILLE SHALES AND SANDSTONE.—About 100 feet of shales and sandstones (soft) of various colors, nearly non-fossiliferous; contains occasional streaks of limestone. Localities as before.

PALEONTOLOGY.

Following is a list of the fossils of the county so far as known. The numerals represent the strata in which they are found as numbered in the text. Doubtful species are queried (?). Liberal allowance must be made for lack of literature in determination.

Lophophyllum proliferum, McChes. 2, 4, 7, 8, 18.
Undetermined, 2.
Archæocidaris agassizi, Gein. 2, 4, 8.
Campophyllum torquium, Owen, 8.
Delocrinus hemisphericus, (——), 7 (S. A. Miller's identity).
Fenestella limitaris, Ulr. ? 4*, 8*.
Fenestella sevillensis, Ulr. 4*, 8*.
Fenestella compressa, Ulr. 4*, 8*.
Fenestella modesta, Ulr. ?? 4*, 8*.
Polypora spiniodata, Ulr. ? 4*, 8*.
Rhombopora varius, Ulr. 4*, 8*.
Rhombopora lepidodendroides, Meek, 4.
Synocladia biserialis, Swall. 4.
Streblopora nicklesi, Ulr. 4*, 8*.
Stenopora carbonaria, Ulr. 4*, 8*.
Stenopora carbonaria var. conferta, Ulr. ? 4*, 8*.

* Prelim. Rep. Geol. Surv. Kan., 1868, p. 19. Geographical names have been applied as far as possible to all strata; but this name and that of the "Spring Rock" are quite appropriate and not liable to be confused with anything else in this section, and hence they are left.

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Blatostomella interstincta, Ulr. 4, 8*.
Productus cora, d'Orb. 2, 4, 7, 8, 14, 16, 18, 21.
Productus costatus, Sow. 4, 7, 8.
Productus longispinus, Sow. 2, 4, 7, 8, 14, 16.
Productus nebrascensis, Owen, 2, 4, 7, 8, 12, 16, 18.
Productus punctatus, Mart. 2, 4, 8, 16.
Productus semireticulatus, Meek, 4, 7, 8, 14, 16.
Productus symmetricus, McChes. 6, 7.
Productus pertenuis, Meek, 2, 4, 7, 8.
Productus undetermined, 7.
Undetermined, 14.
Chonetes granulifera, Owen, 2, 4, 7, 8, 11, 12, 14, 15, 16, 18.
Chonetes? undetermined, 16.
Chonetes glabra, Hall, 7, 8.
Spirifer cameratus, (Hall) Meek, 2, 4, 7, 8, 14, 16.
Spirifer lineatus, Mart. 2, 4.
Spirifer planoconvexus, Shum. 2, 4, 7, 8.
Spiriferina kentuckiensis, Shum. 2, 4, 7, 8.
Rhynconella uta, Marcou, 2, 7.
Rhynconella undetermined, 8.
Discina nitida, Phill. 4, 7, 9.
Discina convexa, Shum. 7, 8.
Lingula mytiloides, Sow. 7, 9.
Lingula umbonata, Cox, 7.
Athyris subtilita, Hall, 2, 4, 7, 8, 11, 12, 14, 16, 18, 21.
Retzia mormonii, Marcou, 4, 7, 8, 11, 14.
Derbya crassa, (Phill.) H. & C. 2, 4, 7, 8, 14.
Derbya robusta, H. & C. 2, 4, 8, 14.
Meekella striocostata, Cox, 2, 14, 18.
Undetermined, 18.
Terebratula bovidens, Mort. 2, 4, 8, 12.
Syntrielasma hemiplicata, (Hall) M. & W. 2, 8, 16, 18.
Undetermined, 16.
Myalina undetermined, 9.
Myalina? undetermined, 7.
Myalina perattenuata, M. & H. 7, 14.
Myalina recurvirostris, M. & W. 2, 14.
Myalina subquadrata, Shum. 2, 14.
Myalina swallovi, McChes. 2, 4, 7, 8, 9, 21.
Allorisma costata, M. & W. 16.
Allorisma geinitzii, Meek?, 16.
Allorisma granosa, (Shum.) Meek, 2, 4, 7, 8, 9, 14, 16.
Allorisma subcuneata, M. & H. 2, 4, 8, 16.
Allorisma winchellii, Meek??, 7, 9.
Allorisma undetermined, 4, 8, 16.
Yoldia undetermined, 16.
Pseudomonotis hawni, M. & H. 21.
Monoptera marian, White, 4, 8.
Monoptera? undetermined, 21.

*The bryozoa from strata numbers 4 and 8 were accidentally mixed, and it is impossible to tell from which the various specimens came, but they are from one or the other, while some are from both.

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Undetermined, 8.
Aviculopecten coxanus, M. & W. 7, 8.
Aviculopecten carboniferus, Stev. 7, 8.
Aviculopecten hertzeri, Meek, 8.
Aviculopecten cf. lyellii, Daws. 8.
Aviculopecten mccoyi, M. & H. 8.
Aviculopecten neglectus, (—), 8.
Aviculopecten occidentalis, Shum. 2, 7, 9, 14, 16, 21.
Aviculopecten winchellii, Meek??, 4, 7.
Aviculopecten whitei, Meek??, 3, 7, 9.
Aviculopecten undetermined, 2, 4.
Nuculana bellistriata, Stev. 7, 9, 16.
Nuculana bellistriata, var. attenuata, Meek, 7, 8, 9.
Solenomya radiata, M. & W. 7.
Solenomya? undetermined, 8.
Entolium aviculatum, (Swall.) Meek, 2, 4, 7, 8, 14, 16.
Schizodus curtus, M. & W. 4, 7, 16.
Schizodus curtiforme, Walcott, 4, 8, 16.
Schizodus rossicus, De Verne, 4, 8.
Avicula longa, (Gein.) Meek, 7.
Lima retifera, Shum. 7, 8.
Nucula ventricosa, Hall, 7, 9.
Pinna peracuta, Shum. 2, 4, 7, 8, 11, 16.
Pinna subspatulata, Worthen, 2.
Macrodon tenuistriata, M. & W. 4, 8, 16.
Macrodon undetermined, 4.
Prothyris elegans, Meek, 7.
Aviculopinna americana, Meek, 8.
Undetermined, 7.
Dentalium meekianum, Gein. 18, 20.
Machrocheilus intercalaris, M. & W. 16.
Machrocheilus angoliferus, White, 7.
Machrocheilus ventricosus, Meek, 7.
Machrocheilus primigenius, (Con.) Hall, 8.
Machrocheilus undetermined, 14.
Loxonema undetermined, 8.
Cf. Murchisonia marcouiana, Gein. 4.
Aclis swallovina, (Gein.) Meek, 4.
Euomphalus subrugosus, Hall, 7, 8, 9, 16.
Anomphalus rotulus, M. & W. 7.
Bellerophon bellus, Keyes, 7.
Bellerophon percarinatus, Con. 7, 14.
Bellerophon carbonarius, Cox, 4, 8, 11, 14.
Bellerophon textilis, Hall, 16.
Bellerophon montfortianus, N. & P.? 15, 16.
Bellerophon undetermined, 8.
Orthonema sublæniatum, Gein. 7.
Naticopsis nana, M. & W. 7.
Naticopsis ventricosa, (N. & P.) M. & W. 7, 8.
Naticopsis wheeleri, Swall.? 2.
Naticopsis altonensis, McChes. 8.
Pleurotomaria grayvillensis, N. & P. 7.

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Pleurotomaria illinoiensis, Worthen, 7.
Pleurotomaria perhumerosa, Meek, 7.
Pleurotomaria sphærulata, Con. 7, 14.
Pleurotomaria subdecussata, Gein. 7, 11.
Pleurotomaria tabulata, Hall, 2, 8.
Nautilus occidentalis, Swall. 8, 14.
Orthoceras undetermined, 4.
Orthoceras undetermined, 14, 16.
Orthoceras cribosum, Gein. 7, 8.
Cythere? undetermined, 9.
Phillipsia major, Shum.? 2, 4.
Phillipsia scitula, M. & W. 2, 4, 7, 8.
Nautilus cf. ponderosus, White, 8.
Nautilus cf. planovolvis, Shum. 8.
Peripristis semicircularis, Newb. & Worthen, 4, 8.
Petalodus destructor, Newb. & Worthen, 2, 4, 8.
Fossil worm?? 1.
Fossil worm, 1.

The writer wishes to acknowledge the valuable assistance of Mr. G. Fred. Miller and Mr. T. M. Aderhold in the work connected with this paper; also to express his obligations to Washburn College for the privilege of using their collections as an aid in compiling this list of fossils.

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THE TWENTY-NINTH ANNUAL MEETING.

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TWENTY-NINTH ANNUAL MEETING.

PROCEEDINGS.

The Kansas Academy of Science convened for the opening session of its twenty-ninth annual meeting in the Y. M. C. A. room of Washburn College, Topeka, at 2:30 P. M., December 31, 1896. President D. S. Kelly in the chair.

The following committees were appointed by the president:

Program and press: E. B. Knerr, E. Miller, J. T. Willard.

Membership: B. B. Smyth, J. W. Beede, J. W. Wilson.

Nominations: L. E. Sayre, A. H. Thompson, A. S. Hitchcock.

Resolutions: S. W. Williston, A. S. Hitchcock, A. J. Stout.

Necrology; B. B. Smyth, E. H. S. Bailey.

Time and place for next meeting: E. H. S. Bailey, J. T. Lovewell, E. B. Knerr, A. J. Smith, J. T. Willard.

The secretary called the roll of members and noted those present.

The secretary read the correspondence for the past year.

Treasurer Sayre read his report, which was referred to an auditing committee, as follows: F. O. Marvin, F. W. Bushong, J. T. Willard.

The reading of papers was then entered upon:

1. Barite nodules in wood, E. B. Knerr.
2. An electric method for determining the mechanical equivalent of heat, J. T. Lovewell.
3. On the Pleistocene deposits of Kansas, S. W. Williston.
4. The timbered mounds of the Kaw reservation, C. N. Gould.
5. Alkyl hypobromites, F. W. Bushong.

On motion, Rev. J. D. Parker was made an honorary member.

President Fairchild, of the State Agricultural College, spoke in the interests of a measure in the United States Congress, looking toward a more satisfactory correlation of the work of the national Department of Agriculture, and he desired the coöperation of the Academy.

On motion, the chair appointed a committee of five to prepare a proper resolution, viz.: E. H. S. Bailey, J. T. Willard, E. B. Knerr, F. O. Marvin, A. S. Hitchcock. This committee reported subsequently, as follows:

Resolved, That we recognize the importance of a more stable organization of the divisions of scientific research in the United States Department of Agricul-

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ture, and we heartily indorse a movement in that direction proposed in the present Congress.

A. H. Thompson and J. T. Lovewell, in behalf of the Topeka Philosophical Society, made announcements of a reception and banquet, to be tendered the Academy at 7 P. M. to-morrow in the parlors of the Congregational church.

The program for the evening was announced and Academy adjourned.

Academy assembled at 8 P. M. in Washburn College chapel, with President Kelly in the chair. It was agreed to omit all business and proceed at once to the reading of papers. The following papers, all illustrated by the lantern, were then listened to with great interest by the Academy and visitors :

6. The detection of adulteration in coffee, L. E. Sayre.
7. Mars and his moons, E. Miller.
8. The pollination of *Asclepias cornuti*, W. C. Stevens.

Adjourned, to meet in the morning in the Senate Chamber of the state-house, to hear the retiring president's address.

Academy was called to order by President Kelly. In the absence of both vice-presidents, E. H. S. Bailey was called to the chair. The President's address was then heard: "Science in the Public Schools."

A vote of thanks was voted President Kelly for his very able and timely address.

Vice-President Williston was called to the chair.

On motion, a committee was appointed to look into the matter of science teaching in the public schools, and to report at the next annual meeting of the Academy. Chair appointed D. S. Kelly, S. W. Williston, and A. S. Hitchcock.

The following papers were then called for and read:

9. Origin of coal, A. J. Smith.
10. Injurious insects, S. J. Hunter.
11. Water of crystallization and experiments with liquid ammonia, H. P. Cady.

Adjourned, to meet in the afternoon at Washburn College.

Academy assembled at 2:30 P. M., in Washburn College chapel. President Kelly occupied the chair.

The committee on nominations reported:

For president: S. W. Williston.
First vice-president: D. E. Lantz.
Second vice-president: A. S. Hitchcock.
Secretary: E. B. Knerr.

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Treasurer: J. W. Beede.

Librarian: B. B. Smyth.

Curators: A. H. Thompson, B. B. Smyth, J. W. Beede.

On motion, the secretary was instructed to cast the ballot of the Academy for these officers.

The following papers were read:

12. Equus beds in central Kansas, J. W. Beede.

13. Efficiency of salicylic acid as a preservative of cider, E. H. S. Bailey.

14. The Mentor beds of Salina, A. W. Jones.

15. A preliminary report on the geology of Effingham ridge, J. W. Wilson.

16. Prehistoric mounds in Cowley county, C. N. Gould.

17. A weather-bureau kite, T. B. Jennings.

18. Notes on the ecological plant geography of Manhattan, A. S. Hitchcock.

19. Additions to the grasses of Kansas, A. S. Hitchcock.

20. The buried moraine of the Shunganunga, B. B. Smyth.

Adjourned, to meet at 9 A. M. to-morrow.

In the evening, the Academy assembled in the parlors of the First Congregational Church, to partake of a banquet given by the Topeka Philosophical Society in honor of the Academy of Science. A very enjoyable evening was had, during which the following toasts were responded to:

Master of ceremonies, Dr. A. H. Thompson.

Invocation.— Rev. L. Blakesley, of Topeka.

Our guests.— Pres. Geo. M. Herrick, of Washburn College.

Our hosts.— Pres. D. S. Kelly, of State Normal School.

Science and the pulpit.— Rev. A. S. Embree, of Topeka.

Science and education.— Miss Emma F. Root, of Bethany College.

The promotion of happiness in the detection of adulterants in food.— Prof. L. E. Sayre, of Kansas University.

The effect of frosting on poor-wills.— Prof. D. E. Lantz, of the Agricultural College.

Mesochorean greens (illustrated by specimens at hand).— Prof. E. B. Knerr, of Midland College.

Woman in science.— Miss Anna H. Adams, of Washburn College.

Telegram, "Latest news from Mars."— Prof. E. Miller, of the University.

Pushes, pulls and diffusion of the Philosophical Society.— H. R. Hilton, of Topeka.

The efficiency of salicylic acid as a preservative of the chemical knowledge of graduates.— Professor Bailey, of the State University.

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JANUARY 2—9:30 A. M.

Washburn College.— President Kelly called the Academy to order, and introduced President elect S. W. Williston, who took the chair, acknowledging the honor in a graceful little speech.

Minutes of the previous session were read and approved.

The auditing committee reported that they had examined the treasurer's accounts, and found them correct.

The librarian presented his report, which was adopted.

On motion, the executive committee was instructed to place a suitable price on back numbers of the Transactions.

The report of the board of curators was read and accepted. This report called out considerable discussion on the condition of the scientific exhibits in the state-house; and a committee, with Professor Williston as chairman, was appointed to endeavor to secure a salaried officer by state appointment, whose duty it shall be to care for all scientific collections in the state-house.

The following papers were read:

21. So-called "glacial boulders" in McPherson county, J. W. Beede.

22. Some Kansas mineral waters; E. H. S. Bailey.

23. Some Atchison and Nemaha county mineral waters, E. B. Knerr.

24. Some reptilian remains from the Kansas Permian, S. W. Williston.

25. Propagation of erythroniums, E. B. Knerr.

26. Pendulum experiments, J. T. Lovewell.

27. Formalin as a preservative of tissue, O. M. Irelan.

28. Some comparative physiographic forms in Kansas, J. W. Beede.

The following papers were read by title:

29. The Cheyenne bottoms, B. L. Miller.

30. A northern extension of the Comanche in central Kansas, J. W. Beede.

31. The gypsum deposits of Kansas, G. P. Grimsley.

32. The study of natural palimpsests, G. P. Grimsley.

33. The Lachnosterna of Kansas, W. Knaus.

34. Additions to the flora of Kansas, B. B. Smyth.

35. The utilization of a very common weed, L. E. Sayre.

36. A provisional list of the flowering plants of McPherson county, H. J. Harnly.

37. The chemical composition of some rocks used in cement plaster, E. H. S. Bailey.

38. The maximum value of the viscosity of the ether, A. S. Dunstan.

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39. The Arickaree shale, W. N. Logan.

40. Notes and descriptions of Mydaidæ, S. W. Williston.

Mrs. Wood, of Topeka, appeared before the Academy in the interests of a petition to the state legislature to prohibit traveling mesmerists experimenting with children. The matter was referred to a committee: S. W. Williston, A. H. Thompson, Olin Templin.

Professor Bailey, as chairman of the committee on time and place for next meeting, reported that his committee had failed to reach a definite conclusion. Thereupon it was moved that the matter be left to a committee consisting of E. H. S. Bailey, J. W. Wilson, C. S. Parmenter, to report to the secretary in ample time before the next meeting.

The committee on resolutions reported the following, which was unanimously adopted:

Resolved, That the hearty and appreciative thanks of the Kansas Academy of Science be tendered to the president and faculty of Washburn College for the excellent facilities afforded the meetings of the Academy; to the members of the Topeka Philosophical Society for their most hospitable and generous entertainment, and to the citizens of Topeka who have aided in making the present sessions of the Academy successful and interesting.

S. W. WILLISTON,
A. S. HITCHCOCK,
J. W. WILSON,
Committee.

At the various sessions of the Academy, the following new members were elected: E. M. Hoisington, Great Bend; J. E. Shacklett, Fall River; C. W. Pratt, Howard; E. N. Parker, Potwin; F. W. Bushong, Emporia; Peter McVicar, Topeka; Edward Bumgardner, Lawrence; O. M. Irelan, Topeka; H. L. Nelson, Topeka; E. H. Heacock, Topeka; Benjamin L. Miller, Lawrence; D. E. Esterly, Topeka; R. B. Dunlevy, Winfield.

Academy adjourned.

E. B. KNERR,
Secretary,

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TRANSACTIONS.

SCIENCE IN THE PUBLIC SCHOOLS.

By D. S. KELLY, Emporia, retiring President, before the Academy January 1, 1897.

Within the past 10 years there has been an unprecedented interest awakened in the natural sciences, both in this country and in the old world. The thought is no longer held that a training in the languages, mathematics and metaphysics constitutes an education; but it is well-nigh universally recognized that science and scientific methods must not only be added, but must be given a prominent place. It is agreed that an ideal course of training should be broad, yet not too comprehensive; that it should be liberal, but not too technical; that it should develop rather than inform; and that it should exercise all of the faculties rather than cultivate some at the expense of the others. The introduction of scientific methods in teaching history, etc., has been attended with gratifying results; but the application of the scientific *method* to history can never take the place of science. What the mind needs are facts based upon personal observation and experiment, and these can best be had in the study of natural history. Mathematics begins with axioms and history with recorded facts, both second-hand, and therefore not of the same interest as things observed and handled, from which the pupil gets thoughts from personal knowledge. Doubtless axioms and facts will agitate cerebral protoplasm; so will a rose; and a rose lives in the earth, while axioms and facts live in books and the minds of men. The scientific method applied to history, etc., has made these studies of greater value to the student than before, yet there is needed something the pupil can call his own as gained by personal contact and observation; hence the great value of natural science. In spite of the fact that natural history surpasses all other studies in value as a basis in developing the young minds, it has been most tardy in finding its way into the curricula of studies in our schools. Physics and chemistry found their way into the schools long before biology, because of the supposed utility of them in the practical affairs of life.

The recent establishment of agricultural colleges has emphasized the importance of study in certain lines of science which would give the pupil the power to acquire to be self-reliant; but no institutions have given more impetus to the study of science than scientific associations. This Academy has been the uplift of many a young man who has grown into prominence in his chosen field of research. The work of this Academy in developing talent has been indeed gratifying; and in the development of the material resources and wealth of the state there can be no computation of the value of this Academy. Yet it seems to me that there is a work for this Academy which it has not undertaken as yet. There is an influence which it can and should exert on the public schools of the state. The condition of science in the public schools is not what it should be. One object of this Academy is to encourage scientific study. We believe the study of nature should begin with the child. And yet in a very large majority of the schools of our state no provision whatever is made upon the daily program for this study. Our boys and girls are compelled to seek information from books alone, and thus dull their perceptive and reasoning faculties. Their education is obtained through the cramming process. They come to believe that because

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a thing is stated in a book it must be so. Eyes have they, but they see not; minds have they, but they reason not. What we need in this country more than anything else, just now, is a system of education that teaches us to examine the facts, gather the data, and upon these base a conclusion. This needs to be taught to all ages, from the kindergarten on up to the college president.

Some few schools are doing good work, systematic work, in science. From such schools there are destined to go out many active observers of nature, and the influence of these schools will be felt in the years to come. And the schools doing the best science work, strange to say, are found in the large cities. This is owing to the energy and interest the superintendent has in such work. He sees the necessities, but is constantly hampered because of the lack of proper material for observation.

There should be an impetus given to this work in our country schools, where the boys and girls are surrounded on all sides by an abundance of material. In many schools the science work has met with what might be regarded as a failure, and there is perhaps no branch of science so poorly taught in our schools (where any is attempted) as zoölogy, and I might add next to this botany. What is the reason for this failure? In most cases the teachers placed in charge of these branches have had no special training in science. They themselves have never learned to observe, and they know nothing of the methods which should be used in such work. Too frequently these branches are given to some teacher whose chief work is in some other line. It is quite easy to predict the result of any work under such conditions. The teacher is forced to treat the subject as he would history or grammar, depend upon the text-book, and the work therefore becomes a pouring in and a memory process. Too frequently the teacher expects too much of the boys and girls, and is constantly forcing them to form conclusions before they have sufficient data of their own; and they soon become discouraged and go to the books for ready formed conclusions.

But the experimentation made in elementary science in the last decade by superintendents and teachers has resulted in much good. They are gradually feeling their way down to the child in this work as in all other subjects. It is claimed by many that a course in natural science cannot be successfully carried out without special teachers. But how ridiculous that seems. If teachers in any public schools had the same training from childhood in natural science that they have had in other subjects, there would attend their efforts the same good results.

The effort for a number of years in the Boston schools attended by failure was due largely to lack of knowledge on the part of teachers, the employment of improper methods, and the use of improper material. When we shall use the children's own elements, the things that are simple to them and within their reach, and discover upon what they work independently with interest, how they work, what methods will best call out their activities and enable them to largely teach themselves, and by what means they can best express their ideas, we shall be on the sure road to successful work. Then there will go out into nature's fields scores of workers where now there is not more than one.

The science of teaching demands a full recognition of an adequate presentation of the subject to be taught. The normal schools rightly claim that a good reproduction naturally follows a good presentation. But unfortunately the reproduction of a subject is too often a failure, because of the *muchness* in presentation. This is especially true in the sciences. The teacher, in making the presentation, sets forth as clearly as possible all the points in the subject. The pupil is left with nothing else to do but reproduce from memory what the teacher

has presented. Some teachers acquire great reputation through their skill in developing a subject, logically bracketing-out the syllabus, as some one has said, "on a rod of blackboard." Then comes the reproduction by the pupil, and, if he does not reproduce well, the presentation is thought not to have been clearly done; so it is repeated. This method is said to be psychological and scientific; nevertheless it induces *passivity* (a polite term for laziness), a habit of waiting to be told what to do, and a wrong attitude toward the work of investigation. It is a literary method carried over into science work, with disastrous results.

The very best presentation of a thing is made by the thing itself. The thing must be suitable to the age of the pupils. Experience has shown that when pupils are given simple, natural objects in which they have some interest, and are permitted to observe, draw, and describe in writing, guided only by a few words written upon the blackboard, to show the order of the work, they acquire such a habit of application and power of expression as can be developed in no other way. They are so pleased with the expression of their own ideas that the disposition to appropriate the ideas of others (to save themselves from thinking), or to copy the expressions of others, is entirely counteracted. The most imperative needs of the children are, (1) opportunities to work by themselves; (2) skillful guidance; and (3) generous encouragement.

The "question-and-answer" method is yet a very prevalent one; indeed, it appears to be about the only one known for science by a great many teachers, judging from its general use. In this method the teacher prepares the outlines and questions and determines the probable answers. With a great deal of coaching, he may succeed finally in getting the pupils to give the desired answer. This kind of teaching is very deceptive. A few bright pupils watch the inflections of voice, and can soon tell by observing the teacher's face (instead of observing the natural object) just what the teacher wants them to say, and they say it, while the rest of the class wait to hear what the bright pupils have to tell and try to remember that. The pupils as a whole do not observe or think; and the disposition to make independent investigations is not cultivated.

If the teacher using the question-and-answer method would take a hint from the ludicrous answers frequently given by the pupils, when the objects are beyond their ability to comprehend, and if he would "right about face" and change his objects and methods, there might be some value coming out of such methods. There is a valuable experience to many a boy in eating a green apple.

Here are a few sample answers to questions in teaching elementary science:

1. The *trachea* is the windpipe going from the mouth to the lungs and ramifying throughout all parts of the body.

2. A volcano is a mountain that emits fire, smoke, ashes, and burning saliva.

3. "What is space?" "I can't express it," said the boy timidly, "but I've got it in my head."

4. What is meant by digestion? We mean by digestion that the food is moistened, so that it will not stick by the way. Food must be digested in order to pass through the stomach. The salivary glands digest it. Glands are muscles on each side of your jaw and in the ears.

5. In a description of the spinal column, the teacher was informed that there is a cushion of gristle in between the vertebræ that goes into the holes every night and comes out every morning; and that is the reason why we are taller in the morning than we are night.

6. Another teacher was informed that some whales produced pearls and others ivory. They make ivory out of whalebone, and sometimes oil.

There is much interest now in elementary science both east and west of us

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among teachers, but for some reason that wave has not struck Kansas very hard. The executive committeb of our State Teachers' Association have been asked again and again to give place on the program for papers and discussions on science. Last year there were two short papers on the program, the only ones which I call to mind in the last 10 years. I believe that this Academy can exert an influence in the direction of bringing about more interest in regard to science in the public schools, and we cannot do a more valuable thing to the state, as well as to the Academy, in perpetuating it in future years. I would recommend that an effort be made to secure a science section in connection with the State Teachers' Association. There is such a section now in the National Association.

One reason for the lethargy in science in our schools is that there is no requirement made in sciences for admission into our colleges and universities. Colleges and universities object to recognizing work in science because inferior work is done in the lower schools. Yes, that is true, and will continue to be true so long as nothing is required of them. There are many high schools now in this state which have extensive courses in languages and mathematics and a mere smattering of science. You ask the superintendent why this is so, and he will tell you he is preparing pupils for the University. Should the universities and colleges require a knowledge of elementary science for admission into their classes, it would at once set a standard of proficiency and give an authoritative call which would be a wonderful stimulus toward putting science into the primary and secondary schools. If it be required of teachers to do a certain kind of work in a certain degree of proficiency, these requirements would soon be met. It is also claimed by college men that the lower schools cannot do the work right, if the teachers had the knowledge, from lack of proper apparatus. I maintain that a certain requirement from our universities would bring the apparatus needed to do the work. It is my judgment that the work in science would soon be done as well in all of the lower schools as in any other subject.

According to our present system, the very best 15 or 20 years of the student's life is robbed of the subject which is of the most worth in giving him a foundation for most efficient work, and the result is that most of the young men and women who enter our normal schools and colleges neither know how nor care to observe. They want to see nature through books. And much of the time allotted to science in our higher institutions must be taken up in teaching the pupils how to observe and making them acquainted with the common things about them; while, if this elementary work had been done in the lower schools, the time in the university could be used to give a deeper insight into nature and nature's laws, in carrying on lines of original investigations such as every student should do before he goes out from these institutions.

Indeed, in many of the higher institutions the course and methods of work would suppose a previous training in observation and an acquaintance with much of nature and her phenomena. The students go out of these institutions into our lower schools, and attempt to teach nature, a thing which they do not know outside of the laboratories. Whoever has not collected insects and plants knows not the halo of interest that old lanes and hedgerows can assume. When a teacher is on fire with a subject, he can fire the pupils with interest. And so a teacher that knows not nature in the fields is not fitted to teach elementary science in our public schools.

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WHERE DID MARS GET ITS MOONS?

By E. MILLER, Lawrence, Kan. Read before the Academy December 31, 1896.

Newton's law of universal gravitation is exemplified in the movements of all the heavenly bodies, without exception. The illustration nearest to us is that of our solar system. Planets, asteroids, satellites, meteors, and meteoric swarms are controlled by it, and cannot escape from its power under any circumstances. It makes no difference whether the body moves in an elliptic, parabolic, or hyperbolic orbit, or in the direction of a right line; in any case the law holds good. The body moving may have such a marvelous velocity as to break away from the attraction of other bodies; yet the law remains in operation. In multiple systems of stars, some of whose orbits have been determined, and others whose orbits are now being investigated, the law is found to be valid. It is fair, therefore, to presume from analogy that the universe of matter is all subject to the law that celestial bodies everywhere act upon each other directly as their masses and inversely as the square of their distances.

It is true that the motion of a body in space may be so great as to effectually prevent the operation of the law, in spite of the attracting force of any other body, or of a number of others, or of an indefinitely great number of them, among which the moving body is passing. No. 1830 Groombridge is an example of a star traversing the celestial spaces at a velocity such that in the course of a great number of years the star will escape from the confines of our stellar system, and be forever after lost to our sight. Somewhere, some time, in the far distant future, 1830 Groombridge will be compelled to slacken speed, and acknowledge the supremacy of the law of universal gravitation, and will then no longer "devour its way" at the rate of 230 miles per second; in other words, it will become a captive star amenable to law, and obliged to travel in an orbit of some sort or other. Illustrations of the capture theory are to be found in our own solar system, especially in the case of comets that have entered the system from outer space, and also of those remains of disintegrated comets — meteoric swarms. There are families of comets belonging to our system that became members of it through the powerful influence of the giant planets. In every case of a comet of short period of revolution its orbit is found to be at certain points very close to the orbit of Jupiter, and when the comet's path crosses that of Jupiter, as Professor Young says, "one of the nodes is always near the place of apparent intersection, and if Jupiter were at that point on its orbit at the time when the comet was passing, the two bodies would really be very near each other. The fact as we shall see is a very significant one, pointing to a connection between these erratic bodies and the planet. This is true of all comets whose periods are less than eight years." Some one has recently suggested that the fifth moon of Jupiter is the result of the capture of a comet by the planet. Is it not possible that some of the moons of the giant planets may have been comets taken on the wing, so to speak, and subsequently transformed into satellites?

May not the movements of large comets passing through our system, hundreds of thousands of years ago, account for the backward revolution of the satellites of Uranus and Neptune? In the satellite system of Uranus, which apparently contradicts the theory of the nebular hypothesis, the plane of the orbits of the moons is inclined at an angle of 89°.2 to the plane of the ecliptic. We know that the inclinations of the orbits of the comets range all the way from 0° to 90°.

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Now, putting these two facts together, we may see, first, that if the moons of Uranus and Neptune were formed in harmony with the nebular hypothesis, they acquired their anomalous backward movement of revolution around their primaries through the proximity of one or more large comets that at the time of the change were passing through our system; or, second, the comets moving along orbits that were at certain points close to the orbits of the planets were so completely captured as to have their cometary orbits destroyed, and they themselves transformed into moons, ever after to exist as moons or comet satellites of Uranus and Neptune. In this manner, comets transformed into moons or comet satellites would, by the superior attraction of the planets and their proximity, necessarily change the character of their orbits from that of the parabola to that of the ellipse.

Farther, instead of revolving around both the Sun and their captors, as many of them now do, with the Sun in the principal focus, the comet-satellites would move as do the moons of Jupiter and Saturn, merely attendants upon their primaries as the latter revolve about the Sun. It is pertinent to inquire how a comet, with a tail 50 or 100 millions of miles long, can be changed into a moon-like body. The nebular hypothesis tells how planets and satellites are formed out of rotating masses of nebulous matter; how a portion of that matter is thrown off, of which a controlling central mass has power sufficient to attract to itself all the other particles belonging to it; and how there results from this operation a compact body like that of a moon. A comet has a nucleus from which extends a tail longer or shorter, as the case may be. Near to and under the tremendous attraction of a giant planet, the motion of the comet in its orbit will be set up; an attraction will begin to be exerted upon that part of the tail nearest the nucleus, and a drift of cometary matter started at once toward the now more powerful center of attraction located in the nucleus; and this attracting force will increase as long as the cometary matter of the tail continues to flow toward the head. Portions of the tail may be lost in space, to be ever after invisible, or to become a meteoric swarm.

When our solar system was still in a nebulous condition, and rings of matter were beginning to be thrown off, in all probability nebulous patches or wisps became disengaged, some from the original nebulous field, and afterward some from the planetary masses; and these in time began to exert a powerful influence upon other portions destined to become satellites. The disturbing effects of the nebulous wisps exerted in every direction were sufficient to produce the backward movements of some of the moons.

This theory of necessity implies that the comets or nebulous patches may have been in that early formative state vastly more numerous than now, and of greater mass and density than the satellites themselves, or rather the masses of which the satellites were formed. Otherwise, such wonderful results could not have been produced. It may be supposed, too, that the nebulous patches or wisps referred to were assisted by immense cometary bodies that have not yet lost much of their matter by disintegration. The interplanetary spaces may have been full of nebulous wisps and comets, each working out its own destiny and influencing the destiny of its neighbors, at the time of the world-making of our system. An examination of the nebulæ in Canes Venatici, in Virgo, in Orion, and of the wisps around the Pleiades, will show almost beyond a doubt how such wisp-like and cometary forms do their work. The well-known law of a moving body — that it will continue to move in the direction given it by the original impulse just so long as it remains solely under the control of that impulse — is universally true; but when acted upon by some other force not in the

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same line, its direction will be changed, and the body will move along the resultant line. So it was with the nebulous patches that afterward became planets or satellites; but those that failed to materialize as planets or satellites, as well as the comets that were not transformed into cometary satellites or meteoric swarms, escaped from our system, and so doing left their impress upon some of the members of the solar system, as in the case of the moons of Uranus and Neptune. Their size and number would find better conditions for producing anomalous results on those far distant fields of space than their diminished size and number would find hundreds of millions of miles nearer the center of the nebulous mass about which all were revolving.

The disturbing force, however great, that was exerted by them was not powerful enough to draw the satellites away from the grip of their primaries. Suppose some great attracting force should appear in the midst of, or near to, the Jovian system: At once the moons of that planet would be more or less disturbed; their movements would be radically changed, or Jupiter might lose them altogether. A comet of immense size, such as Laplace suggested as a possibility, might even destroy the mechanism of the Jovian system entirely. The same may be said both of the Saturnian system and the Earth-Moon system.

There lies between the orbits of Mars and Jupiter a belt of tiny planets, the so-called asteroids, of which more than 400 have been discovered, and to the list of which new ones are added every year. Whether they came into existence, each as an independent body, or all were formed originally out of the nebula as a single planet, like the Earth or Mars, and then by a series of explosions, first of the planet itself, and then of the fragments as they were hurled in various directions into space; or still in the form of a planet, it was struck by some immense body on its way through the solar system from the depths of space—a comet or other unknown visitor—it matters not. Some of these little bodies have great eccentricity of orbit. Liberatrix, the 125th of the asteroids, discovered by Professor Henry in 1872, is, when nearest the Sun, 184 millions of miles distant from that luminary, and when farthest the distance is increased to 380 millions, making the longest axis of its orbit vastly greater than its shortest. Æthra, 132d, discovered by Watson in 1873, is a little over 149 millions of miles distant when nearest the Sun, and 333 millions of miles when farthest away. The longest axis of Æthra is at least 184 millions of miles longer than its shortest.

The inclination of the orbit of Æthra to the plane of the ecliptic is 25°, a little greater than the Earth's obliquity. Now, when Mars is nearest to the Earth, at the time of its most favorable opposition, the planet is distant from the Sun 128 millions of miles, and when farthest from the Sun, Mars is 154 millions of miles distant. But the inclination of the orbit of Mars to the plane of the ecliptic differs considerably from that of the asteroid Æthra. Let us compare the distance of Mars when farthest from the Sun with the distance of Æthra when nearest the Sun and ascertain if possible the probable results of such an investigation. The following table of measurements of the orbit of Mars, as given by Holden, and the corresponding one for the asteroid Æthra, compiled by Mr. D. P. Todd, of Amherst College, will assist in reaching a conclusion:

Nearest the Sun, Mars is 128 millions of miles distant; Æthra 149 millions. Farthest from the Sun, Mars is 154 millions of miles distant; Æthra 333 millions. Eccentricity of orbit of Mars is .093; of Æthra, .38. Inclination of orbit of Mars is 1° 51′; of Æthra, 25°.

The great eccentricity of the orbit of Æthra as compared with that of Mars, taken in connection with the nearest distance of Æthra to the Sun and that of Mars when farthest, will show that if the two orbits were in the same plane that

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of Æthra would intersect that of Mars at two points and at various times, once certainly when Mars would be passing aphelion and the asteroid perihelion. The accompanying figure will illustrate the supposition, the plane of the paper representing the plane of the orbits.

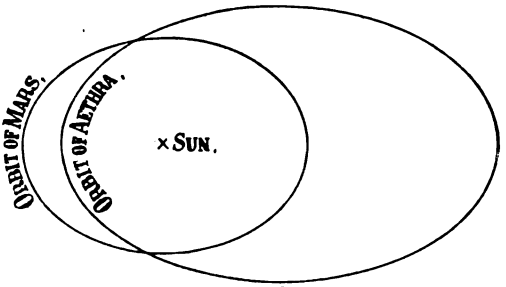

Fig. 1.

Anywhere to the right of the Sun's place, Mars would exert a tremendous pull on the asteroid, and especially so at the points of intersection. But as the orbit of the asteroid cuts the plane of the ecliptic at an angle of 25°, and that of Mars at an angle of 1° 51′, then the probability that the planet and the asteroid will pass through the plane of the ecliptic at the same or nearly the same time, and at points relatively the same, as if both in the same plane, will be somewhat diminished, but far from vanishing.

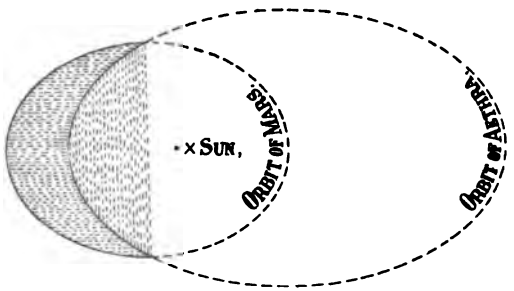

Fig. II.

In figure II the plane of the paper represents the plane of the ecliptic, the large ellipse the plane of the asteroid's orbit, the small ellipse the orbit of Mars. It is clear that notwithstanding the great difference between the angle formed by the intersection of the orbit of the asteroid and the plane of the ecliptic, and that by the intersection of the orbit of Mars and the plane of the ecliptic, there will come a time when the planet and the asteroid will get very near each other. Then the attraction of Mars at such close range, will be sufficient to change forever the direction of motion, and the plane of the orbit of the asteroid. What will then be the fate of Æthra? Under the conditions named, the asteroid will be transformed into a moon revolving about Mars as its primary, and so constituting one of the family of the planet.

However many asteroids there are, or whatever the width of the asteroidal belt is, it may be considered probable that there are hundreds or perhaps thou-

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sands of them so small as to be invisible even with the best telescopes, many of which move in orbits quite adjacent to the orbits of both Jupiter and Mars. Not only may some of them become satellites of the two planets, but there may be satellites of the two, invisible as yet, that were once asteroids pursuing their way around the Sun, influenced by the perturbing influences of either Jupiter or Mars. The asteriodal belt may, for all we know, extend all the way from the orbit of Mars to that of Jupiter, and the liability that some of them should be captured by their giant neighbors becomes almost, if not altogether, a certainty.

Then, if all the foregoing be true, it may be affirmed with a reasonable degree of probability that the two moons of Mars, Deimos and Phobos, at one time in the far distant past were members of the asteroidal group. Their size also seems to indicate their origin, one of which, the larger being not more than 16 miles in diameter, and possibly only seven miles. The time of revolution of Phobos, the inner moon, is 7 hours 39 minutes. That is to say, it revolves about Mars a little more than three times every 24 hours, and presents all the different phases of new moon, first quarter, full moon, and last quarter, at each revolution. Young says that "this rapidity of revolution raises important questions as to the theory of the development of the solar system, and requires modification of the views which have been held up to the time of their discovery. If the nebular hypothesis is true, a shortening of the satellite's period or a lengthening of the planet's day must have occurred since the satellites came into being." Now, a shortening of the satellite's period of revolution indicates that its orbit has been contracted to smaller dimensions; and this shortening may have been going on for a long time, so that at the time the shortening began the satellite was far enough away to be in the zone of asteroids; in fact, an asteroid itself.

The conclusion, therefore, which was referred to in the beginning of this discussion, is that, owing to the proximity of the asteroidal belt, the intersection of the orbits of Mars and Æthra, the small size of the asteroids and the moons of Mars, the red planet captured its moons from the asteroidal group. And, if this be so, then Jupiter some time in the past has done a like thing.

The future, supplied with more powerful telescopes and appliances, may reveal to our gaze more moons still revolving about the two planets, of which some were captured, and since that time have been playing the role of satellites.

NOTES ON INJURIOUS INSECTS.

By S. J. Hunter, Lawrence, Kan. Read before the Academy January 1, 1897.

The year just closing has witnessed the recurrence of some familiar insect pests, and the presence of forms strange to many because of previous scarcity in this locality.

The notes that follow are based upon correspondence received at the department of entomology and upon field observations made by members of the department.

Army-worm (*Leucania unipunctata*).

First appearance in state, 1876; again, 1891. This year present in damaging numbers in Douglas, Leavenworth, Ottawa, Brown, Harvey, Cloud and Ellsworth counties.

The worm is the larva of a fawn-colored moth of variable size, average having wing expanse of an inch and a half. Front wings freely sprinkled with black

dots. Back of center of each wing is the characteristic white spot. The hind wings are translucent gray.

The eggs are deposited upon dead grass and old stubble between stalk and base of leaves. Some adults emerge late in the fall; the majority, however, appear early in the spring. When newly hatched the larva is dull white in color. When full grown its general color is dingy black with five light longitudinal stripes. The common name comes from great multitudes moving in one direction. The traveling habit is not instinctive, but forced by scarcity of food brought about by presence of large numbers.

Among the remedies for checking this pest are burning old grass, stubble, and old trash liable to form receptacles for eggs and hibernating larvæ. Doubtless the custom of burning all grass lands in this state in the years of early settlement accounts for the comparative absence of this worm. Ditching and fencing will prevent the progress of worms from one field to another until they may be destroyed by crushing. While this enemy of agriculture is legion, it is pleasing to note that its natural enemies are many. So effective are these predacious and parasitic insects* that the larvæ often disappear before they have become ready to pupate.

WHEATHEAD ARMY-WORM (*Leucania albilinea*, Guenée).

Numerous reports of the ravages of this insect came from various localities in the northern and western parts of the state during May and June. Hodge Bros. wrote from Abilene "The ground is covered and they are doing great damage." John E. Frost, land commissioner of the Santa Fe railway, estimated the damage over central and western Kansas to the wheat to be from 1 to 25 per cent. of the crop. The other reports were alike in tone.

The adult insect is a moth expanding about 1½ inches, front wings pale straw, hind wings satiny white. The larva, a brown and pale yellow caterpillar, feeding at night, eats the kernels out of the head of wheat, leaving a head of chaff. The casual observer will first see an abundance of chaff around the foot of the plants. It appears about (Riley) the time wheat is in the milk. Its first recorded appearance in this state was in 1876.

Prof. J. B. Smith, in *Insect Life*, Vol. VI, pp. 189, 190, says: "This is one of those creatures against which we are more or less helpless; and the only advice that I was able to give to the farmers was to harvest their wheat just as soon as they possibly could. The advice was followed very generally, and a conservative estimate placed on the damage done was 10 per cent. of the crop. A very large proportion of these larvæ were parasitized, principally by a tachinid fly, but the fact that so large a proportion was parasitized did not, so far as I have been able to ascertain, lessen the injuries sustained by the farmers in the least."

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*Insects attacking army-worms:

PREDACIOUS BEETLES	Cicindela 6-guttata, Fabr.
	Harpalus caliginosus, Fabr.
	Calosoma calidum, Fabr.
	Calosoma externum, Say.
	Calosoma scrutator, Fabr.
	Calosoma wilcoxi, Lec.
	Pasimachus elongatus, Lec.
	Cicindela repanda, Dej.
	Elaphrus ruscarius, Say.
	Amara angustata, Say.
	Harpalus pennsylvanicus, Dej.
FLIES	Yellow-tailed tachinid fly, Exorista lucaniæ, Kirk.
	Exorista flavicauda, Riley.
HYMENOPTERA	Microgaster militaris, Walsh.
	Penzomachus minimus, Walsh.
	Ophion purgatus, Say.
	Ichneumon leucania.

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FOREST TENT-CATERPILLAR (*Clisiocampa sylvatica*, Harris).

From the southeastern portion of the state, notably Chautauqua and Elk counties, come reports of the defoliation of both forest and apple trees by a caterpillar formerly unknown in these localities. Specimens sent to the department were recognized as the forest tent-caterpillar.

The eggs from which the worm hatches are deposited by the moth, about the middle of June, in layers surrounding the twig at an equal depth, the ends of the cylindrical mass being squarely docked. This square ending enables us to distinguish this insect clearly from the apple-tree tent-caterpillar (*Clisiocampa americana* Harris), whose egg masses taper gradually down to the twig. I call especial attention to this fact here, since in the egg state our best opportunity for prevention occurs. The eggs in each mass number about 400. In color they are cream white. The mass is shaped similar to a truncated cone slightly rounded at the base. Eggs are protected from the weather by a brown varnish. The mass remains unchanged over winter, during which time they are easily detected upon the leafless trees.

The young hatch from this mass about the last of the following March; and, though the buds may not have opened, these little creatures are wonderfully hardy, can fast for two or three weeks if need be and withstand much inclement weather. The full-grown caterpillar is pale blue, tinged on sides with gray, and everywhere sprinkled over with black dots. It measures about an inch and a half in length. The common name arises from the little web or tent spun by the larva in the nearest fork. Here they live in company, moving out from time to time to feed upon surrounding leaves and increasing the size of their habitations as they grow.

The artificial remedies are destroying egg masses wherever found, spraying leaves with London purple or Paris green, destroying caterpillars collected in tents. The most effective remedy, however, is pruning off in the winter time the easily-detected egg masses upon the twigs of the leafless trees.

SPRING CANKER-WORM (*Anisopteryx vernata*, Peck).

In the spring the writer visited a number of orchards almost defoliated by the small grayish measuring worm. The worm is about an inch in length, travels with looping motion, and when disturbed lets itself down from the limb by a silken thread.

The wingless female issues in spring from chrysalids which have passed the winter in the ground, and soon deposits its eggs. These hatch about the time the leaves unfold from the bud, and are full-fed, ready to pupate, the latter part of May. The apple crop in north-central counties was seriously affected by this pest.

Among the many remedies, spraying, with either London purple or Paris green, during the heat of day when larvæ are most active, is the most effective after the worm has appeared on the trees.

Barriers formed by small rolls of rags placed around the trunk of the tree a foot or so from the ground, then freely coated with tar, prevents the ascent of the wingless female to deposit eggs and, later, the larvæ to feed. Spraying, however, at this time serves two purposes. In addition to destruction of canker-worm, the young codling-moth worm is also destroyed in the flower of the forthcoming apple. The quality of the apples gathered from orchards so sprayed under direction of the department was highly satisfactory to the owners, who commented freely upon absence of worms in mature fruit.

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ELM-TWIG GIRDLER (*Oncideres cingulatus*, Say).

Shade trees, prominent among them the elm, were liberally pruned this fall by this industrious wood-cutter. Its presence is made known by the numbers of small branches strewn beneath the trees. In these branches are to be found the eggs deposited singly at the base of the twigs beneath the bark. This insect was reported at work in Atchison, Dickinson, and Douglas counties.

A number of the adults were kept in the laboratory during their working season this fall, and careful study made there, as well as upon affected trees on the campus. Mr. P. E. Parrott, a student of this department, has given this subject special attention, and will report fully later on.

CHINCH-BUGS (*Blissus leucopterus*, Say).

The life-history and the destructive habits of this insect are too well known to require further description. The department has continued the dissemination of the infectious diseases. Repeated demands from some localities each year and highly satisfactory reports from a great majority of farmers using the remedy are gratifying to the department. While no further funds are at hand for the prosecution of the work, the department has decided to continue the work and render still effective service to the agriculturists, the only requirement being that all demands for infection be accompanied by postage for delivery of diseased bugs.

The above is a brief summary of the work of the most destructive insects during the past year. These lilliputians are enemies well worthy the attention of every agriculturist. While many points are familiar, there is much to learn in order to more successfully cope with them. The department will highly appreciate reports and coöperation of the Academy and others interested in making the desired knowledge more complete.

NOTES AND DESCRIPTIONS OF *MYDAIDÆ*.

By S. W. WILLISTON, Lawrence, Kan. Read (by title) before the Academy January 2, 1897.

Collections of Diptera, even large ones, rarely include many specimens or species of *Mydaidæ*. The extent of individual variation is, in consequence, not well known. I have had the opportunity of studying most of the known genera and nearly 30 species. Much of the literature is inaccessible to the general student. I trust, therefore, that the following tables of the North American species will be useful, notwithstanding that they have been in large measure compiled from the often incomplete descriptions:

LEPTOMYDAS.

I would call attention to the fact that the sexes differ very markedly in coloration in this genus, and I suspect that the species described by Osten Sacken from females may not in each case be distinct from those described by Loew from males.

1.—Black, legs for the most part black 2
Luteous or reddish, legs yellow or rufous 3

2.—Proboscis short, the labella not incrassate; first posterior cell closed; femora black, the knees reddish; wings blackish. . *tenuipes* Loew (male).
Base of hind femora and their tibiæ light yellow; wings cinereous hyaline; first posterior cell open ..... *venosus* Loew (male).

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3.—Proboscis long, the labella small; thorax brownish red with yellow stripes; abdomen with yellow bands; legs rufous, base of hind femora whitish; wings with a yellowish tinge ..... *sponsor* O. S. (female).
Proboscis short 4
4.—Luteous, the abdomen black-fasciate, labella incrassate, legs yellow; wings brownish, first posterior cell open..... *pantherinus* Gerst. (female).
Thorax and abdomen red or brownish red; legs pale rufous; wings with a pale brownish tinge..... *brachyrrhynchus* O. S. (female).

Leptomydas brachyrrhynchus O. Sacken. A male specimen from Mexico, which I refer to the present species, is black throughout, the abdomen shining, with the cross-bands distinct. The legs are brown; the hind pair black, with the basal half of tibiæ and femora light yellow. The humeri are yellow. The wings are nearly hyaline. The species, it is seen, must be closely related to *L. tenuipes* Loew.

L. pantherinus Gerst. For the male of this species, compare Williston, Trans. Amer. Ent. Soc., XIII, 291.

MYDAS.

1.—Hind tibiæ without spur..... *parvulus* Westw.
Hind tibiæ with spur..... 2
2.—Posterior marginal cross-vein present 6
Posterior marginal cross-vein wanting..... 3
3.—Abdominal segments uniform in color ..... *senilis* Westw.
Abdominal segments marginated 4
4.—Mesonotum ferruginous, with a broad black stripe in the middle, *basalis* Westw.
Mesonotum and antennæ black 5
5.—Hair of the face white (compare *M. gracilis* Macq.)... *annularis* Gerst.
Hair of the face black..... *subinterruptus* Bell.
6.—Abdomen black or blue throughout..... 16
Abdomen with yellow or red markings 7
7.—Abdomen black with one or more of the anterior segments red or yellow. 8
Abdomen otherwise marked 11
8.—Second segment only of the abdomen red..... 9
Second, third and fourth segments red..... 10
9.—Second segment red above, only..... *clavatus* Drury.
Second segment red above and below ..... *audax* O. Sacken.
10.—Face clothed with yellowish hair ..... *fulvifrons* Illiger.
Face clothed with black hair ..... *cleptes* O. Sacken.
11.—Abdomen red or brownish red, with black spots 12
Abdomen with some or all the segments margined with yellow 13
12.—Abdomen with a median spot on each segment.... *maculiventris* Gerst.
Abdomen usually with a black spot on each side of the segments; thorax vittate (*ventralis* Gerst.)..... *militaris* Gerst.
13.—Second and third abdominal segments with a posterior yellow band, *interruptus* Wied.
chrysostomus O. Sacken.
Posterior segments also marginated with yellow..... 14
14.—Antennæ of the usual structure..... 15
Lamella of antennæ longer than three preceding joints together, broadest at base (compare *M. gracilis* Macq.) ..... *scitulus* Willist.
15.—Reddish, legs reddish..... *pachygaster* Westw. (male).
Black, legs black..... *quadrilineatus* Will.

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16.—Legs black 19
Legs more or less red or yellow 17
17.—Legs wholly yellow ..... *fulvipes* Walsh.
Legs in part black 18
18.—Tibiæ and tarsi yellow ..... *tibialis* Wied.
Hind femora largely or wholly red; thorax red ..... *tricolor* Macq.
19.—Abdomen with more or less yellow hair or pile 20
Abdomen with black hair or pile only 21
20.—Abdominal segments, 2–5, with a broad band of short, appressed golden rufescent pile, not concealing the ground color when seen vertically, *chrysites* O. Sacken.
First two or three segments with yellow hair; alulæ conspicuously yellow ..... *dives* Westw.
21.—Wings nearly hyaline ..... *crassipes* Westw.
Wings yellow or brown ..... *rubidapex* Wied.
lavatus Gerst.
xanthopterus Loew.
decor O. Sacken.
carbonifer O. Sacken.
bitæniatus Bell.
luteipennis Loew.
simplex Loew.

MYDAS *fulvifrons* Illiger. A single specimen, from Florida, in the University collection, agrees well with Illiger's description; less well with Wiedemann's, though I doubt not the species is the same.

MYDAS *decor* O. Sacken. Two specimens, from New Mexico (F. H. Snow) and Venta de Zapilote, Mexico.

MYDAS *basalis* Westwood. Numerous specimens from New Mexico (F. H. Snow). Westwood's description leaves no doubt of the identification of this well-marked species.

MYDAS *carbonifer* O. Sacken. A single specimen from Chapada, Brazil, I refer provisionally to this species. The specimen agrees with the description, save that the interior of the cells of the wings is distinctly lighter colored, and the claws are not reddish. There are some whitish hairs on the face.

MYDAS *rubidapex* Wiedemann; Brauer, Syst. Zool. Stud. pl. f. 2. Three specimens, from Mexico. One, a female, has the antennæ black, with the bulbous portion of the lamella yellow. This same specimen has the anal angle largely whitish. The others, male and female, have the first two joints of the antennae, only, black, and neither has any whitish color in the anal angle. In all the specimens the abdomen is deep black, without distinct violet or blue luster. A single specimen from Yucatan has the alulæ black, but the abdomen is deep violet. I discover no other differences.

MYDAS *dives* Westw. Five specimens, male and female, from Brazil, appear to belong to this species, especially characterized by the light yellow alulæ, which show very conspicuously in the folded wing. The wings are yellow, with the posterior part yellowish hyaline. The abdomen is brilliant blue, with yellow pile at the base. The specimens vary in length from 38 to 50 millimeters, but they are not nearly so robust as that of the species mentioned below.

MYDAS ——sp.? A large specimen from Mexico I at first thought might belong to a variety of *dives*, and I am not sure that it is distinct. The wings

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are ferruginous, as in *rubidapex*, but the alulæ and anal angles are yellowish white throughout, or the alulæ for the larger part. The abdomen is black, with scarce a trace of the bluish color, and there is no yellow pile at the base. Baron Osten Sacken identified a specimen from Mexico as *dives* differing chiefly from *rubidapex* in the color of the alulæ. In *rubidapex* the abdomen is black, or is so typically, while in *dives* Westwood described it as blue. A specimen from Yucatan, mentioned under *rubidapex*, holds an intermediate position between this and the two other species, if species they are.

MYDAS —— sp.? A single female specimen from Chapada, Brazil, I cannot locate. It is, I believe, the largest specimen of a dipteron ever recorded, measuring 50 millimeters in length with a spread of wings of over 100. I cannot identify the present species with *M. heros* Perty, inasmuch as there is no yellow pile on the abdomen and the abdomen is deep black, not blue. The wings are deep brown with the posterior part yellowish. The lamella of the antenna is red.

MYDAS *claripennis*, n. sp. Female. Black. Lamella of the antennæ moderately dilated toward the extremity. Front with black, the face with white hair. Mesonotum moderately shining, with seven densely white pollinose spots, situated one either side of the middle, in front, one on each side above the notopleural suture, a minute one in front of each post-alar callus, and a larger one in front of the middle of the scutellum. Pleuræ whitish pruinose; a tuft of white hair on the hind coxæ. Abdomen shining; first segment with loose white hair; second, third and fourth segments each with a broad band of light golden hair, closely appressed and combed outward, concealing the ground color. Hind femora moderately thickened; hind tibæ with a spur. Wings nearly hyaline, slightly brownish in the costal and subcostal cells and distally; posterior marginal vein present. Length, 20–25 mm.

One specimen, Chapada, Brazil (H. H. Smith). The banded abdomen and clear wings easily distinguish this species. It is nearest related to *M. chrysites* O. S.

MYDAS *militaris* Gerst.

Mydas vittatus Macq. (preoc.); ? *Mydas rufiventris* Macquart; ? *Mydas rufiventris* Loew; *Mydas ventralis* Gerst.

It is not at all improbable that the above synonymy will be found to be correct; if so, the species should bear the name *rufiventris* Macq. The species is very variable, as I have stated elsewhere. The hair of the face and front in my specimens is yellow.

MYDAS *quadrilineatus*, n. sp. Male. Black. The narrow frontal orbits and the sides of the face, extending to the root of the antennæ above, densely yellowish gray pollinose; pile of face, front and occiput everywhere white. Lamella of antennæ considerably expanded, equal to about two-thirds the length of the third joint. Mesonotum opaque, with two linear stripes, and the narrow lateral margins light grayish yellow pollinose; humeri whitish dusted. Pleuræ grayish pollinose, the pteropleuræ and coxæ with white hair. Abdomen shining black, the lateral margins of the anterior segments and their posterior margins laterally yellow. Legs black throughout, with white hair; pulvilli brown; hind tibiæ spurred. Wings brownish, darker in front and along the veins; posterior marginal cross-vein present. Length, 25 to 27 mm.

Three specimens, Mexico (H. H. Smith). The slender markings of the mesonotum may be easily obliterated. With these specimens there are three others from the same localities, that differ only in the presence of complete yellow abdominal bands, and in having the abdomen along the middle, both above

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and below, red. A female from San Blas is larger (30 mm.), and has the abdomen broader, with narrow, complete hind margins to the segments. If the thoracic stripes were present, they have been wholly obliterated.

Johnson has recently stated that *M. incisus* Macq. is the same as *M. pachygaster* Westw. If this be the case, the present species cannot be *M. incisus*, the very brief description of which might possibly apply, except for the thoracic stripes.

MYDAS *annulicornis* Westwood. Male and female specimens from Mexico agree fully with Westwood's description. The hair of the face in both sexes is black throughout. Gerstaecker believed that *annulicornis* is the same as *testaceus*, which has white hair on the sides of the face. The species are in all probability distinct.

MYDAS *cingulatus*, n. sp. Female. Differs from *M. notospilus* Wied. (or what I identify as *notospilus*) in the antennæ being longer, in the wings being dark brown anteriorly, and in the much darker legs. In *M. notospilus* the antennæ are distinctly shorter than the thorax, while in this they are fully as long. The lamella is not longer than the third joint and is less dilated. The face is more protuberant below, and, except the margin, is deep, shining black, with short, sparse, yellowish hairs on the lower part. The antennæ are deep black, save the expanded portion, which is deep red. The four anterior femora are pitchy black, the hind pair deep black. The hind femora are more dilated than in the following species. The wings are deep brown in front, the posterior part yellowish hyaline, the veins broadly brown. Length, 20 mm.

One specimen, "Shore of Rio Paraguay, below Concepcion, Dec. Forest, on ground." H. H. Smith.

MYDAS *notospilus* Wiedemann. A single female specimen, from Brazil, seems to belong to this species, though it shows differences from the description. The antennæ are in large part reddish, the middle of the face is yellowish, the abdomen is less dilated than is figured, the wings are only slightly clouded with brownish. The antennæ are shorter than in the preceding species, and the lamella is considerably dilated. The hind tibiæ are without spurs.

DOLICHOGASTER.

Dolichogaster *ioptera* Wiedemann (*brevicornis* Wied.) Three specimens, Brazil. They agree well with Wiedemann's description, but the generic characters given by Gerstaecker are faulty. In none of these specimens do the branches of the forked cell unite before joining the first vein. In one specimen there is a marginal cross-vein present.

ECTYPHUS.

Ectyphus *limbatus* Williston. This species was described from a female specimen, which seemed to show all the generic characters of *Ectyphus* Gerst.; that is, the presence of a circlet of spines at the tip of the abdomen and the absence of spurs on the hind tibiæ. A male specimen which I believe belongs with this species, notwithstanding the very marked difference of color, has a spur on the hind tibiæ and a prominent, free hypopygium. *E. pinguis* Gerst., the type of the genus, from Africa, has the hypopygium concealed. I can find no other generic distinction, however, and the erection of a new genus upon that one character would seem of doubtful propriety. The genus is nearest related to *Leptomydas*, which has the hypopygium in some species partly disengaged. Here is another character, if more be needed, proving the relationship to the Apioceridæ. Baron Osten Sacken, notwithstanding all the evidence that has been brought to controvert his views, stands yet quite alone in placing the Apioceridæ among the Asili-

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dæ. Chætotactic characters are useful undoubtedly, but when one asserts that they outweigh all others, of whatever kind or degree, I cannot follow him.

Ectyphus *Townsendi*, n. sp. Female. Head black, clothed with white pile; the convex portion of the face, except its upper part, reddish yellow; orbits narrowly white pollinose, extending inwards on the upper part of the face. Antennæ black, the lamella reddish yellow; lamella about three-fifths the length of the slender third joint, elongate oval in outline. Thorax black, slightly pruinose; humeral and post-alar callosities reddish yellow; a spot on each side between the humeri and suture densely white, pollinose. Pleuræ with similar spots on the upper part of the sterno- and mesopleuræ. Abdomen deep, shining black; the posterior part of each segment, both above and below, rather broadly yellow; a small black spot on each side of the second segment in the yellow margin. The abdomen is rather broad, gently tapering, the last segment longer than the preceding one. Legs yellow throughout, slender, the hind femora not thickened (the distal part of the hind femora and the remainder of the hind legs are wanting in the single specimen). Wings yellowish hyaline. Length, 17 mm.

One specimen, Las Cruces, N. M. (Townsend). This species appears to be clearly congeneric with *E. limbatus* Willist., though the absence of the hind tibial spur cannot be affirmed. It differs from the above-cited species in the more elongate antennæ, the less cylindrical shape of the abdomen, and in the color. The male of *E. limbatus* is black, with the markings of the female, and it is probable that the male of this species will show a similar difference.

CERIOMYDAS, *gen. nov.*

Like *Mydas*, but the abdomen as in *Ceria* or *Conops*. The abdomen is pedunculate, much narrowed at the base, broadly expanded and acuminate distally; the first two segments are tapering, the third cylindrical, with parallel sides, and nearly twice as long as wide; the fifth segment is as broad as the thorax, whence the abdomen tapers to a point. The face is more produced downward than in *Mydas*, and the labella are larger. There is a marginal cross-vein in the wings, and the hind tibiæ are spurred.

CERIOMYDAS *fraudulentus*, n. sp. Female. Head black, the sides of the face below reddish. Front with soft white pile; face with two rows of soft, thick, reddish brown hair in the shape of a V, meeting at the oral margin. First three joints and the narrow portion of the lamella of the antennæ deep brown, reddish along the under side, expanded portion of the lamella deep red; lamella altogether about three-fourths the length of the third joint. Mesonotum black, but little shining; humeral and post-alar callosities, the scutellum, and the pleuræ for the most part, deep red. First three segments of the abdomen red, with a slender blackish hind margin; remainder black, but little shining. Legs red; the upper part of the front and the hind femora, and a stripe along the front part of the latter, black or deep brown. Wings with the front part and the base deep brown, elsewhere hyaline; the limitation between the brown and the hyaline parts on the outer portion of the wings is not diffuse, the line running from a little before the middle of the wing antero-posteriorly straight to the tip of the wing; the first and second basal cells are brown throughout, extending diffusely into the discal and posterior cells; the anal angle is less deep brown, and has a large hyaline space along its middle; the alulæ are largely hyaline. Length, 27 mm.

One specimen, Chapada, Brazil (H. H. Smith). This species shows a remarkable mimicry of certain ones of *Conops* occurring in the same region.

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ADDITIONS TO "THE GRASSES OF KANSAS."

By A. S. Hitchcock, Manhattan, Kan. Read (by title) before the Academy January 2, 1897.

The following list includes species of grasses added to the herbarium of the Kansas Agricultural College since the reading of my paper on "The Grasses of Kansas": *

Andropogon halapensis (L.) Brot. Escaped through eastern and southern Kansas.

Paspalum floridanum Mx. Cherokee county.

Panicum agrostidiforme Lam. Cherokee county.

Panicum colonum L. Grant county.

Panicum filiforme L. Cherokee county.

Panicum linearifolium Scribn. ined. Cherokee county.

Panicum pubescens Lam. Wyandotte (Mackenzie), Cherokee county.

Panicum rostratum Muhl. Cherokee county.

Panicum sanguinale ciliare (Retz.) Vasey. Cherokee county.

Panicum sphærocarpon Ell. Cherokee county.

Panicum wilcoxianum Vasey. Riley county.

Chætochloa lævigata perennis Scribn. ined. Comanche county. This is Setaria glauca lævigata of authors. The heads resemble those of Setaria glauca, but are short, usually not more than an inch in length. The root is perennial and the plant is a native. It grows among the other perennial grasses along the river banks.

Aristida dichotoma Mx. Cherokee county.

Aristida gracilis Ell. Wyandotte (Mackenzie).

Oryzopsis membranacea (Pursh.) Vasey. Logan county.

Muhlenbergia sobolifera (Muhl.) Trin. Cherokee county. The specimens so labeled in the previous list are Sporobolus brevifolius (Nutt.) Scribn.

Sporobolus argutus (Nees) Kunth. Pratt county.

Agrostis perennans (Walt.) Tuckerm. Wyandotte (Mackenzie), Atchison.

Danthonia spicata (L.) Beauv. Cherokee county.

Gymnopogon ambiguus (Mx.) B. S. P. Chautauqua county.

Triodia albescens (Munro) Vasey. Kiowa county.

Triodia stricta (Nutt.) Vasey. Crawford and Montgomery counties.

Triodia trinerviglumis Benth. Chautauqua county.

Eragrostis frankii Steud. Atchison county.

Eatonia pennsylvanica (DC.) Gray. Leavenworth county.

Poa sylvestris Gray. Cherokee and Leavenworth counties.

Agropyron tenerum Vasey. Wyandotte county (Mackenzie).

Professor Scribner has kindly determined some of the above species. Mr. Nash has called my attention to the fact that Muhlenbergia diffusa was published by Willdenow in 1797 (Sp. Pl. 1, p. 320), and hence antedates Dilepyrum minutiflorum Mx. (1803).

Paspalum floridanum. Crawford, Labette.

P. mucronatum Muhl. Cherokee.

Panicum agrostidiforme. Montgomery, Anderson, Comanche, Kingman, Chautauqua.

P. colonum. Seward, Edwards, Gray.

P. filiforme. Coffey, Pottawatomie.

*Trans. Kan. Acad. Sci., Vol. XIV, p. 135.

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P. pubescens. Through eastern Kansas.
Chætochloa lævigata perennis. Reno, Stafford, Meade, Gray.
Aristida dichotoma. Kingman.
A. gracilis. Montgomery, Chautauqua.
Muhlenbergia capillaris (Lam.) Trin. Elk, Chautauqua.
Brachyelytrum erectum (Schreb.) Beauv. Wyandotte (MacKenzie).
Sporobolus argutus. Stafford, Edwards.
Agrostis elliottiana Schultes. Chautauqua.
Chloris elegans HBK. Reno.
Eatonia pennsylvanica. Montgomery, Cherokee.
Poa sylvestris. Bourbon, Montgomery, Nemaha.
Agropyron tenerum. Cheyenne.

ADDITIONS TO THE FLORA OF KANSAS.

By B. B. Smyth, Topeka. Read (by title) before the Academy January 2, 1897.

The past two years have been a very fruitful period in botanical work. More collectors than usual have been at work in Kansas, and altogether it has been a period of unusual activity. The results of the work of the government collector, Mr. Chas. H. Thompson, through the southern and southwestern parts of the state in 1893, have been worked up by Prof. A. S. Hitchcock, and published by the Division of Botany at Washington, D. C., as a contribution from the United States National Herbarium.

Professor Hitchcock has explored pretty thoroughly the southeastern, southern, and, with his assistants, the southwestern parts of the state, and added many new plants to the herbarium of the Agricultural College.

The writer has taken a second trip along the line of the Arkansas river from Hutchinson to Coolidge, at the west line of the state, and returned through Wichita, Scott, Ness, Barton, McPherson and Marion counties. The use of a bicycle and the usually splendid condition of the roads in the western parts of the state greatly facilitated visiting remote places. Much of interest and value was collected and noted on the trip. A trip into Allen, Anderson and Woodson counties was also taken, and some important collections made. Add to this that some of the material collected on previous trips into the southwestern, western and northwestern parts of the state has been worked up; though there still remains some work to be done in determining plants of recent and former collections.

Mr. Elam Bartholomew, of Rockport, Rooks county, has worked incessantly among the parasitic fungi, and has not only discovered many plants new to the state, but has discovered many that are new to science. A part of the results of his work is here given.

Mr. J. A. Rich, of Ellis, has collected pretty thoroughly the plants of Trego county and has made some collections in Gove. Nearly 400 specimens have been sent down by him to the state herbarium from Trego county and 26 from Gove county. Among all these are several that have been hitherto unreported, and most of these are given in the following list, though a few yet remain to be determined.

Numerous plants have been sent in from nearly all parts of the state by people who were unfamiliar with them. Nearly all such have proved to be familiar or well-known plants, and the names returned to the senders. In case the plants

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happened to be of economic interest, descriptions and remarks concerning such have been published in the *Kansas Farmer*.

The following list contains the names of plants published for the first time in this Flora of Kansas or Additions; and in all cases where first publication was made outside the state, the place of such publication is given. Where no such credit is given, this is first publication.

FLOWERING PLANTS.

— Argemone alba Lestiboudois. (Hitchcock, in Bull. Kan. Exp. Sta., "Kansas Weeds," No. 2.) This has been in the State herbarium for a long time, labeled "*Argemone platyceras* L. & O." Botanists seem disposed to recognize two species of *Argemone* in this state; but the differences are differences of degree, not of kind. The forms are too near alike to be considered as separate species, or even strongly marked sub-species. The elder name is *A. alba;* the name *A. platyceras* must fall.

1. Erysimum inconspicuum MacMillan. (Metasp. Minn. Val., 1892, p. 268.) Thomas county; frequent. In State herbarium.

2. Sophia incisa Greene. (Pittonia, 1896, p. 95.) "Kansas." Britton, in Illust. Flora Northern U. S. and Can., II, 145. This does not appear to agree with the plant, which is very common in Kansas, and heretofore listed under the name of *Sisymbrium canescens.*

3. Cristatella erosa Nutt. Hamilton county; rather common in the sand-hills (Hitchcock). Cont. U. S. Nat. Herb., III, 541 (1896).

4. Arenaria fendleri Gray. Hamilton and Wichita counties; frequent in rocks. Also sent in from Trego county by J. A. Rich. (No. 87.)

5. Arenaria hookeri Nutt. Trego county; in State herbarium, sent in by J. A. Rich. (No. 25.) Also collected by the writer in Norton, Decatur, Sherman, Wichita, Hamilton, and Finney counties.

6. Arenaria texana Britton. Norton county; frequent. In State herbarium. Determined by Dr. B. L. Robinson, in Proc. Amer. Acad., 1894, p. 302.

7. Cerastium brachypodum Robinson. Shawnee county; occasional. In state herbarium.

8. Loeflingia texana Hook. Wichita county; in State herbarium.

9. Astragalus kentrophyta Gray. Wichita county; in State herbarium.

— Astragalus filifolius (Gray). Hamilton county; in State herbarium. Heretofore listed under name of *A. pictus filifolius* Gray.

10. Astragalus scobinatulus Sheldon. Hamilton county; abundant (Hitchcock). Cont. U. S. Nat. Herb., III, 543 (1896).

11. Desmodium longifolium Nutt. Sedgwick county (Carleton).

12. Lespedeza nuttallii Darl. Kansas (N. L. Britton). Trans. N. Y. Acad. Sci., XII, 1893, p. 61.

13. Lespedeza violacea Pers. Kansas (N. L. Britton). L. c., p. 62.

14. Orophaca cæspitosa Britton. Kansas (E. P. Sheldon). Bull. Geol. Surv. Minn., IX, 117, (1894,) under name of *Astragalus gilviflorus.*

15. Petalostemon macrostachyus Torr. Grant county; on sandy knolls along south fork of Cimarron; rare (Hitchcock). Cont. U. S. Nat. Herb., III, 543, (1896).

16. Petalostemon decumbens Nutt. Chalk hills of Meade and Pratt counties. In State herbarium. Closely related to *P. oligophyllus.*

17. Petalostemon oligophyllus Torr. Phillipsburg; abundant in old brickyard and other abandoned diggings. In State herbarium. Heretofore listed under name of P. gracilis, it being considered by Doctor Torrey a variety of that species; but now regarded by A. A. Heller as a distinct species. Some of its

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forms grade close to P. candidus; but the latter species, which is common throughout the state, may be readily distinguished by its thinner leaflets, more compact inflorescence, fewer, longer, and more cylindrical spikes (commonly only one), more acuminate bracts, and more solitary and strictly upright habit.

18. Psoralea micrantha Gray. Riley county (Kellerman). Bull. Torr. Bot. Club, 1894, p. 94.

— Agrimonia hirsuta Bicknell. (Bull. Torr. Club, 1896, p. 511; pl. 282, fig. 1.) Shawnee county; frequent. This is the species that is listed in Smyth's Checklist of the Plants of Kansas as "forma *intermedia*."

19. Agrimonia mollis Britton. (Bull. Torr. Club, 1892, p. 221; 1896, p. 515; pl. 282, fig. 3, Bicknell.) Shawnee county; common enough. In State herbarium.

— Amelanchier spicata Dec. Low Juneberry. Introduced into Kansas by nurserymen, and having a slight tendency to run wild.

20. Cerasus besseyi (Bailey). Western sand cherry. Phillips county; frequent in dry hills. In State herbarium. Too near *Cerasus pumila* to be considered a separate species.

21. Cercocarpus parviflorus H. & A. Western Kansas. N. L. Britton, in Illust. Flora, II, 223.

— Fragaria americana Britton. (Bull. Torr. Club, XIX, 222.) This is the wild strawberry of our fields and woods instead of *F. vesca*, as heretofore reported. There is really very little difference, hardly enough upon which to erect a new species; but if there is any difference the patriotic American will recognize it for the sake of the name.

22. Potentilla recta L. Topeka; one or two bunches introduced from the east found in the state yard before improvement. Listed heretofore as P. gracilis.

23. Prunus watsoni Sargent. Sand plum. Central and western Kansas. First collected by Dr. Louis Watson, of Ellis.

24. Adelia acuminata Mx. Labette county. Reported by Dr. W. S. Newlon.

25. Epilobium lineare Muhl. Anderson county; in a marshy place; not frequent. In State herbarium.

26. Œnothera fendleri Gray. Sherman county; in bluffs; not frequent. In State herbarium.

27. Mentzelia multiflora Gray. Hamilton county; frequent in cultivated lands and sedimentary deposits in the low land (Hitchcock). Cont. U. S. Nat. Herb., III, 545 (1896).

28. Sanicula gregaria Bicknell. Fort Riley (E. E. Gayle). Bull. Torr. Club, 1895, p. 354.

29. Grindelia grandiflora Hook. Trego county; sent in by J. A. Rich. (No. 317.) This differs so decidedly from *G. squarrosa* that it is entitled to rank as a species. In *G. squarrosa* the leaves are spatulate to linear-oblong or obovate, with crenulate-denticulate to spinulosely serrulate teeth; usually slightly gummy and covered with minute translucent dots; the scales of the involucre are attenuate and recurved or squarrose and very gummy and sticky; the leaves near the heads are reduced, and there are no bracts immediately under the heads. In *G. grandiflora* the leaves are elliptical to ovate, broadest in the lower half, not dotted or gummy, and having spinosely-dentate teeth, like those of the American holly, or softly aristate, almost ciliate, serrate teeth; margin of leaves and teeth pale; the scales of the involucre are acuminate, appressed, and only slightly gummy; and each head is subtended by a leafy bract, almost laciniate, the serrations are so deep.

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30. Hymenatherum aureum Gray. Hamilton county; on an island in the Arkansas river, five miles east of Syracuse; rare. Hitchcock, Cont. U. S Nat. Herb., III, 545.

31. Hymenopappus flavescens Gray. Grant county hillsides. Hitchcock, l. c., p. 547.

32. Krigia oppositifolia Raf. Dwarf dandelion. Shawnee county; rare. Collected by W. A. Harshbarger. In the State herbarium.

33. Lygodesmia rostrata Gray. Hamilton county; north slope of sand-hills. Hitchcock, Contrib., III, 548.

34. Vernonia marginata Britton. Morton county; by a pond in North fork of Cimarron; rare. Hitchcock, l. c., 545.

35. Gilia aggregata Spreng. Stevens county; abundant in the sand hills. Hitchcock, Contrib., III, 548.

36. Gilia inconspicua Sweet. Hamilton county, on land subject to overflow by the river; rare. Hitchcock, l. c., 548.

37. Echinospermum texanum Scheele. Hamilton county, on ditch banks; rare. Hitchcock, l. c., 549.

38. Heliotropium curassavicum L. Grant county, in bottom of dried-up ponds; abundant. Hitchcock, l. c., 548.

39. Cuscuta neuropetala Engelm. Hamilton county; frequent in low lands. Hitchcock, l. c., 549.

40. Chamæsaracha conioides Britt. Hamilton county; frequent about excavations. Hitchcock, l. c., 549.

41. Physalis comata Rydberg. Rooks county (Bartholomew). Bull. Torr. Club, 1895, 306.

42. Physalis macrophysa Rydb. Shawnee county (Popenoe). Rydberg, l. c., 308.

43. Collinsia violacea Nutt. Cherokee county. This was first found by Thos. Nuttall, in 1833, in the Indian Territory, "on the hills and upland woods of the Arkansas and Red rivers," and is represented as abundant. (See Trans. Amer. Philos. Soc., n. s., V, 179.) It has rarely been collected since, and is therefore a "little-known species," according to Gray in Synop. Flora of N. A. Collected in Cherokee county and reported this year (1896) for the first time from Kansas, by Chancellor F. H. Snow. It differs from *C. verna* in its thickish leaves, violet flowers (about three to a whorl instead of six), and in having its capsules about 10-seeded.

44. Atriplex canescens James. Trego county; not rare. In State herbarium. Sent in by J. A. Rich. (No. 258.)

45. Atriplex nuttallii Watson. Gove county; sent in to State herbarium by J. A. Rich. ("Y")

46. Salsola tragus L. Russian thistle. Sent in by W. G. Riste, from Colby. Sent in also from Greeley, Norton, Cloud, Republic, Jewell, Phillips, and Decatur counties.

47. Eriogonum campanulatum Nutt. Gove county; in State herbarium. Sent in by J. A. Rich. ("X")

48. Eriogonum cernuum Nutt. Sherman county; in State herbarium.

49. Polygonum littorale Link. Shawnee county; in State herbarium.

50. Euphorbia stictospora Engelm. Coolidge, Kan., on dry hills. In State herbarium. Sent also from Trego county, by J. A. Rich. (No. 262.)

51. Corylus rostrata Ait. Kansas. Britton, in Illust. Flora, I, 508.

52. Sagittaria ambigua J. G. Smith. McPherson county; collected by J. E. Bodin, 1887, and by A. S. Hitchcock, 1892. Smith, in Ann. Rep. Mo. Botanic Garden, 1895, p. 48; pl. 17.

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53. Sagittaria arifolia Smith. Trego county; in State herbarium. Sent by J. A. Rich. (No. 218.)

54. Sagittaria calycina Engelm. Shawnee county; frequent in fresh water. In State herbarium.

— Sagittaria latifolia Willd. Common in eastern Kansas; specimens in variety in Kansas herbarium. This has heretofore been listed under name of *S. variabilis* Eng.

55. Sagittaria longiloba Eng. Western Kansas. Smith, l. c., p. 42; pl. 11.

— Spiranthes cernua L. C. Rich. Trego county; sent in by J. A. Rich. (No. 331.) This is an additional locality for this rare plant.

56. Juncus aristulatus Mx. Cherokee county (W. S. Newlon). F. V. Coville, in Proc. Biol. Soc. Wash., VIII, 1893, 124.

57. Juncus balticus Willd. Barton county; in State herbarium.

58. Juncus diffusissimus Buckley. Southeastern Kansas. Coville, in Illust. Flora, I, 396.

59. Juncus marginatus Rostk., subsp. setosus Coville. Stafford and Kingman counties. Carleton, in Cont. U. S. Nat. Herb., I, 217.

60. Juncus robustus Cov. Southeastern Kansas. Coville, in Illust. Flora, I, 395.

61. Carex castanea Wahl. Morris county; in State herbarium.

62. Carex filifolia Nutt. Barton county; frequent. In State herbarium.

63. Carex interior Bailey. Bogs and swamps, Kansas. L. H. Bailey, in Bull. Torr. Club, 1893, p. 426.

64. Carex lanuginosa Mx., subsp. Kansana Britton. Kansas. Britton, in Illust. Flora, I, 305.

65. Cyperus hallii Britt. (Bull. Torr. Club, XIII, 211.) Kansas. Britton, in Illust. Flora, I, 240.

66. Cyperus ovularis Torr. Shawnee county; in State herbarium.

67. Eleocharis atropurpurea Kunth. Frequent in wet places in western Kansas. Collected in Pratt county by the writer. Sent in also from Trego county, by J. A. Rich. (No. 231.)

68. Fimbristylis castanea Vahl. Shawnee county; not common. In State herbarium.

69. Fuirena simplex Vahl. Kingman county. In State herbarium. Sent in by Mrs. James Jackson.

70. Hemicarpha subsquarrosa Nees, subsp. aristulata Cov. Kingman county (Carleton). Coville, in Bull. Torr. Bot. Club, 1894, p. 36.

71. Scirpus campestris Britton. Garden City. In State herbarium. Collected by the writer.

72. Scirpus lineatus Mx. Shawnee county. In State herbarium. Collected by the writer.

73. Aristida fasciculata Torr. Trego county; sent to State herbarium by J. A. Rich. (No. 380.) This differs from *A. purpurea* in being taller and not so deep a purple. The awns, too, are only slightly divergent.

74. Brachyelytrum erectum Beauv. Shawnee county; occasional in slightly shaded, moist spots. In State herbarium. Collected by the writer.

75. Lolium temulentum L. Topeka; frequent. In State herbarium. Collected by the writer.

76. Oryzopsis cuspidata Vasey. Collected in Phillips county by the writer. In State herbarium.

77. Panicum obtusum HBK. Ford county; occasional. In State herbarium. Collected by the writer.

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78. Panicum pubescens Lam. Shawnee county; occasional in gardens, in shelter of blackberry bushes. In State herbarium. Collected by the writer.

— Panicum scribnerianum Nash. This is the grass that has been known in this state as *P. scoparium* Lam. Mr. Geo. V. Nash points out (Bull. Torr. Club, 1895, 421) that *P. scoparium* Lam. grows only in the southern mountains, and names our grass *P. scribnerianum*, as stated.

— Poa arida Vasey. No. 1716 of Smyth's Check-list, collected in Saline county in 1887 by Joseph Henry, and in Rooks county in 1892 by Elam Bartholomew, and listed as *Poa andina* Nutt., has a new name given by Dr. Geo. Vasey; because it is not the same species as *Poa andina* of Chili, though it was supposed to be by Nuttall. Cont. U. S. Nat. Herb., I, 270.

79. Poa wolfli Scribn. Kansas. Scribner, in Bull. Torr. Club, 1894, p. 228.

80. Sporobolus argutus Kunth. Seward county; collected by the writer. In State herbarium.

81. Sporobolus longifolius Wood. Collected at Wichita in 1890. Determined by Geo. V. Nash. Bull Torr. Club, 1895, p. 463.

— Sporobolus texanus Vasey. Cloud and Republic counties. Collected by John H. Schaffner, Columbus, Ohio. This was listed in "Additions to the Flora of Kansas," Trans. Kan. Acad. Sci., XIII, p. 102, as found in Clark county by Mr. Carleton. Mr. Schaffner's find is the farthest north from which this grass is yet reported.

FUNGI.

Hymenomycetes (*Mushrooms*).

82. Tricholoma semivestitum Peck. On old grass roots in sandy prairie, Rooks county (Elam Bartholomew). Dark brown pileus. Chas. H. Peck, in Bull. Torr. Bot. Club, 1895, 485.

83. Lepiota mutata Peck. Ground in woods, Rooks county, July, 1896 (Bartholomew). L. c., 1896, 411.

84. Collybia microspora Peck. Wet ground under bushes, Rooks county (Bartholomew). Lamellæ pure white, changing to rusty brown in drying. L. c., 1895, 486.

85. Marasmius subtomentosus Peck. Abundant on roots of grass and other plants in sandy soil, Rooks county (Bartholomew). L. c., 487.

86. Marasmius badius Peck. Decaying sticks lying on wet ground, Rooks county (Bartholomew). L. c., 487.

87. Pistillaria bartolomæi Ellis & Everhart. On dead stems of *Callirhoe involucrata*, Rooks county (Bartholomew). Proc. Acad. Nat. Sci. Phila., 1893, p. 441.

88. Volvaria striatula Peck. Wet ground, under weeds, Rooks county (Bartholomew). Peck, Bull. Torr. Club, 1895, 487.

89. Pluteus stercorarius Peck. Manure heaps, Rooks county (Bartholomew). L. c., p. 448.

90. Flammula decurrens Peck. Wet ground in shade of bushes, Rooks county (Bartholomew). Sulphur yellow. L. c., 489.

91. Stropharia cæsifolia Peck. Low sandy pastures, Rooks county (Bartholomew). Lamellæ light blue. L. c., 489.

92. Hypholoma cutifracta Peck. About stumps of Lombardy poplar, Rockport (Bartholomew). L. c., 490.

93. Psathyrella leucostigma Peck. Wet ground under trees (Bartholomew). L. c., 490.

94. Psathyrella bartholomæi Peck. Rich ground in shade of trees (Bartholomew). L. c., 490.

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95. Psathyrella gracillima Peck. Damp ground, among weeds, Rooks county, July, 1896 (Bartholomew). L. c., 1896, 417.

96. Psathyrella debilis Peck. Damp ground, attached to decaying stems, Rooks county, July, 1896 (Bartholomew). L. c., 418.

97. Coprinus calyptratus Peck. Open cultivated ground, Rooks county (Bartholomew). L. c., 1895, 205.

98. Coprinus ebulbosus Peck. At the base of cottonwood stumps, Rooks county (Bartholomew). L. c., 491.

99. Coprinus laniger Peck. Base of cottonwood stumps, Rooks county (Bartholomew). L. c., 491.

100. Polyporus kansensis Ellis & Bartholomew. On the base of a rotten stump, Pottawatomie county, October, 1893 (Bartholomew). Erythea, IV, 1896, p. 1.

101. Polyporus cryptopus E. & B. On the ground in sandy pastures, attached to dead grass roots, Rooks county, July, 1895 (Bartholomew). Erythea, l. c., p. 79.

102. Polyporus bartholomæi Peck. Decaying sticks and chips on damp ground, Rooks county, July, 1896 (Bartholomew). Peck, Bull. Torr. Club, 1896, 418.

103. Tylostoma punctatum Peck. Sandy ground in pastures, Rooks county, July, 1896 (Bartholomew). L. c. 419.

Myxomycetes (Slime Molds).

104. Stemonitis webberi Rex. Collected by H. J. Webber, Manhattan. Ferruginous-colored spores. Dr. Geo. A. Rex, in Proc. Acad. Nat. Sci. Phila., 1891, p. 390.

105. Cribraria violacea Rex. Collected by W. T. Swingle, Manhattan. L. c., 394.

106. Hemiarcyria varneyi Rex. Collected by Miss May Varney, Manhattan. L. c., 396.

Pyrenomycetes (Black Fungi).

107. Rosellinia limoniispora Ellis & Everhart. On dead leaves of *Fraxinus*, Rooks county (Bartholomew). Proc. Acad. Nat. Sci. Phila., 1894, p. 326.

108. Rosellinia cæspitosa E. & E. On dead limbs of *Celtis occidentalis*, Rooks county (Bartholomew). L. c., p. 327.

109. Rosellinia ostiolata E. & E. On bark of *Ulmus americana*, Rooks county (Bartholomew). L. c., 327.

110. Rosellinia pinicola E. & E. On a weatherbeaten pine board, Rockport (Bartholomew). L. c., 327.

111. Rosellinia muriculata E. & E. On inner surface of bark of *Populus monilifera*, Rooks county, December, 1894 (Bartholomew). Perithecia black and muriculate-roughened. Ellis & Everhart, l. c., 1895, 416.

112. Melanomma moriculum E. & E. On dead limbs of *Morus*, Rooks county (Bartholomew). L. c., 1894, 328.

113. Melanomma dealbatum E. & E. On old decorticated, weatherbeaten cottonwood logs, Rooks county (Bartholomew). L c., 328.

114. Melanomma subcongruum E. & E. On outer bark of cottonwood trees, Rooks county, September, 1894 (Bartholomew). L. c., 1895, 417.

115. Trematosphæria fraxini E. & E. On dead limbs of *Fraxinus viridis* that had lain in water for some time, Rooks county (Bartholomew). L. c., 1894, 329.

116. Chætomium glabrescens E. & E. On a rotten limb, probably willow, Rooks county (Bartholomew). L. c., 1893, 130.

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117. Teichospora aspera E. & E. On old cottonwood boards, Rockport (Bartholomew). L. c., 131.

118. Teichospora amygdaloides E. & E. On the bark of *Salix amygdaloides*, Rooks county (Bartholomew). L. c., 1894, 330.

119. Teichospora clavispora E. & E. On bark of *Negundo aceroides*, Rockport (Bartholomew). L. c., 330.

120. Teichospora crossota E. & E. On the weathered inner surface of elm bark, Rooks county (Bartholomew). L. c., 331.

121. Teichospora piriospora E. & E. On outer bark of *Celtis occidentalis*, Rooks county (Bartholomew). L. c., 331.

122. Teichospora nubilosa E. & E. On outer bark of *Celtis occidentalis*, Rooks county (Bartholomew). L. c., 332.

123. Teichospora minima E. & E. On a dry oak post, Rockport, October, 1894 (Bartholomew). L. c., 1895, 419.

124. Lophiostoma asperum E. & E. On outer bark of *Ulmus americana*, Rockport (Bartholomew). L. c., 1894, 332.

125. Lophiostoma speciosum E. & E. On bark of *Fraxinus viridis*, Rooks county (Bartholomew). L. c., 332.

126. Lophiostoma clavisporum E. & E. On dead culms of *Elymus canadensis*, Rooks county, March, 1895, 419.

127. Lophidium pachystomum E. & E. On outer bark of *Populus monilifera*, Kansas (Bartholomew). L. c., 1894, 333.

128. Lophidium confertum E. & E. On decorticated, decaying limbs of *Fraxinus viridis*, Trego county (Bartholomew). L. c., 334.

129. Didymosphæria celtidis E. & E. On dead limbs of *Celtis occidentalis*, Rooks county, May, 1895 (Bartholomew). L. c., 1895, 421.

130. Leptosphæria occidentalis E. & E. On *Panicum crus-galli*, Rooks county (Bartholomew). N. A. Fungi, Cent. xxx, 1893.

131. Metasphæria maximiliani E. & E. On dead stems of *Helianthus maximiliani*, Rockport (Bartholomew). Proc. Acad. Nat. Sci. Phila., 1893, 136.

132. Ophiobolus helianthi E. & E. On dead stems of *Helianthus maximiliani*, Rooks county, March, 1895 (Bartholomew). L. c., 1895, 423.

133. Thyridium pallidum E. & E. On dead stems of *Rhus glabra*, Rooks county, May, 1895 (Bartholomew). There is no outward indication of the fungus except the numerous, small, round perforations in the epidermis; but, when this is stripped off, the surface of the inner bark is seen to be dotted with the round, pallid, slightly-prominent apices of the perithecia. L. c., 1895, 424.

134. Anthostomella suberumpens E. & E. On inner surface of loosened elm bark, Rooks county (Bartholomew.) L. c., 1894, 338.

135. Eutypella amorphæ E. & E. On dead stems of *Amorpha fruticosa*, Rooks county (Bartholomew). L. c., 1894, 140.

136. Diaporthe stereostoma E. & E. On dead branches of *Symphoricarpos occidentalis*, Rooks county (Bartholomew). L. c., 1894, 338.

137. Valsa ribicola E. & E. On dead *Ribes aureum*, Rooks county (Bartholomew). L. c., p. 340.

138. Calosphæria cornicola E. & E. On dead limbs of *Cornus asperifolia*, Rooks county (Bartholomew). L. c., p. 342.

139. Pseudovalsa viticola E. & E. On dead shoots of *Vitis riparia*, Rockport (Batholomew). L. c., p. 343.

140. Valsaria allantospora E. & E. On dead *Negundo aceroides*, Rooks county (Bartholomew). L. c., p. 343.

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141. Diatrype celastrina E. & E. On dead stems of *Celastrus scandens*, Rooks county (Bartholomew). L. c., p. 343.

142. Anthostoma formosum E. & E. On bark of dead *Celtis occidentalis*, Rooks county (Bartholomew). L. c., 344.

143. Diatrypella fraxini E. & E. On dead limbs of *Fraxinus viridis*, Rooks county, July, 1895 (Bartholomew). L. c., 1895, 426.

144. Phyllachora asterigena E. & E. On living leaves of *Aster oblongi folius*, Rooks county (Bartholomew). L. c., 1894, 345.

145. Histerium cedrinum E. & E. On weather-beaten wood of white cedar post, Rockport (Bartholomew). L. c., p. 346.

Discomycetes (Cup Fungi).

146. Cenangella violacea E. & E. On an old cottonwood board, Rooks county (Bartholomew). Proc. Acad. Nat. Sci. Phila., 1893, 149.

147. Cenangella thujina E. & B. An exposed wood of white cedar post, Rockport, February, 1894 (Bartholomew). Erythea, 1896, p. 3.

148. Blitrydium symphoricarpi E. & E. On dead twigs of *Symphocarpos vulgaris*, Rooks county (Bartholomew). Proc. Acad. Nat. Sci. Phila., 1895, 427.

149. Dothidella longissima (Pers.) E. & E. On dead stems of *Chenopodium album*, Kansas (Bartholomew & Shear). L. c., 1895, 427.

150. Stictis fusca E. & B. On dead branches of *Symphoricarpos occidentalis*, Rooks county, February, 1894 (Bartholomew). Erythea, 1896, 3.

151. Patellea hysterioides E. & E. On weather-beaten pine lumber, Rooks county (Bartholomew). L. c., 1895, 429.

Ustilaginæ (Smuts).

152. Ustilago sorghi Pass. Common on sorghum; on kaffir-corn, Manhattan (Kellerman); and on broom corn, Phillipsburg. J. B. S. Norton, in Trans. Acad. Sci. of St. Louis, 1896, p. 231, pl. xxv, figs. 1–5.

152. Ustilago ischæmi Fuckel. In inflorescence of *Andropogon provincialis*, Rooks county, E. Bartholomew. Norton, l. c., p. 231.

153. Ustilago austro-americana Speg. In inflorescence of *Polygonum pennsylvanicum*, Riley and Republic counties. Norton, l. c., p. 231, pl. xxviii, figs. 9–12.

154. Ustilago aristidæ Peck. In ovaries of *Aristida*, Hodgeman and Ellis counties. Norton, l. c., p. 232, pl. xxv, figs. 19–23.

155. Ustilago spermophora Berk. & Curt. In ovaries of *Eragrostis major*. Norton, l. c., p. 233.

156. Ustilago vilfæ Wint. In inflorescence of *Sporobolus vaginæflorus*. Manhattan, December, 1895. Norton, l. c., p. 233.

157. Ustilago rabenhorstiana Kuhn. Common in inflorescence of *Panicum sanguinale*, and less often on *P. glabrum*. Norton, l. c., p. 233, pl. xxvi, figs. 4, 5, and xxvii, 6–8.

Ustilago reiliana Kuhn. On sorghum, Manhattan, and on corn, Riley, Morris, Saline, Jewell and Geary counties; rather common. Norton, l. c., p. 233, pl. xxv, figs. 14–18.

159. Ustilago neglecta Niessl. On *setaria glauca*, Manhattan. Norton, l. c., p. 234, pl. xxviii, figs. 7, 8.

160. Ustilago syntherismæ Ell. & Everh. On *Panicum*, *Cenchrus*, etc., Manhattan; rather common. Norton, p. 235; pl. xxvi, figs. 1–3, 6–13; xxvii, 1–3, 9–12; xxix, 6–8.

161. Ustilago utriculosa Tul. On *Polygonum acre*, Rooks and Barton counties, and *P. pennsylvanicum*, Riley. Norton, l. c., p. 236.

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162. Ustilago andropogonis Kell. & Swing. Common on *Andropogon provincialis* from several places in the state, and on *A. hallii*, Arkalon and Harper. Norton, l. c., p. 236; pl. xxvi, figs. 14–17.

163. Ustilago bouteloues K. & S. In ovaries of *Bouteloua oligostachya*, Rooks and Riley counties. Norton, l. c., p. 236; pl. xxix, fig. 11.

164. Ustilago pustulata Tracy and Earle. On *Panicum proliferum*, Pottawatomie county (Crevecœur). Norton, l. c., p. 237.

165. Ustilago filifera Norton. On *Bouteloua racemosa* and *P. oligostachya*, Riley and Wabaunsee counties. Norton, l. c., 1896, p. 237; pl. xxviii, figs. 1 2, 4–6; xxix, 1–4, 9, 10.

166. Ustilago minor Norton. On leaves of *Bouteloua hirsuta*, Manhattan; rare. Norton, l. c., p. 238; pl. xxviii, fig. 3; xxix, 5, 12.

167. Tilletia fœtans Schroet. On wheat, common, Kansas. Norton, l. c., p. 238.

168. Tilletia tritici Wint. On wheat, Rooks and Greeley counties. Norton, l. c., p. 238.

169. Tilletia buchloeana K. & S. In ovaries of *Buchloe dactyloides*, Jewell county (Miss Dahl); Trego and Ford counties (Kellerman & Swingle). Norton, l. c., p. 239.

170. Tilletia rotundata E. & E. In ovaries of *Panicum virgatum*, Manhattan, December, 1895. Norton, l. c., p. 239.

171. Doassansia (probably occulta). On *Potamogeton*, Lawrence (M. A. Barber). Norton, l. c., p. 240, foot-note.

172. Sorosporium solidaginis E. & E. In the inflorescence of *Solidago missouriensis*, Rooks county (Bartholomew). Proc. Acad. Nat. Sci. Phila., 1893, p. 156.

173. Sorosporium atrum Peck. On *Carex pennsylvanica*, Manhattan, 1894 (J. E. Payne). Norton, Trans. Acad. Sci. St. L., 1896, 240.

174. Sorosporium cuneatum Schof. In stems and inflorescence of *Solidago missouriensis*, Rooks and Riley counties. Norton, l. c., p. 240; pl. xxvii, figs. 4, 5.

175. Urocystis anemonis Schroet. On leaves of *Anemone caroliniana*, Rooks county (Bartholomew). Norton, l. c., p. 240.

Uredinæ (*Rusts*).

176. Puccinia ludibunda E. & E. On leaves of *Carex sparganioides*, Rooks county (Bartholomew). Proc. Acad. Nat. Sci. Phila., 1893, 153.

177. Puccinia virgata E. & E. On dead leaves of *Panicum virgatum*, Rooks county (Bartholomew). L. c., 154.

178. Puccinia bartholomi Dietel. On *Bouteloua oligostachya*, Rooks county (Bartholomew). N. A. Fungi, Cent. XXX, 1893.

179. Puccinia kansensis E. & B. On leaves of *Buchloe dactyloides*, Rooks county, September, 1894 (Bartholomew). Erythea, 1896, p. 1.

180. Puccinia jubata E. & B. On culms and sheaths of *Hordeum jubatum*, Rooks county, March, 1895 (Bartholomew). L. c., p. 2.

181. Puccinia sparganioides E. & B. On *Carex sparganioides*, Rooks county, August, 1895 (Bartholomew). L. c., p. 2.

182. Puccinia triodiæ E. & B. On *Triodia purpurea*, Rooks county, August, 1895 (Bartholomew). L. c., p. 3.

183. Puccinia clavispora E. & B. On leaves of *Andropogon nutans*, Phillips county, 1895 (Bartholomew). L. c., 79.

184. Puccinia tecta E. & B. On leaves of *Carex sparganioides*, Rooks county, October, 1895 (Bartholomew). L. c., 79.

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185. Uromyces sporoboli E. & E. On *Sporobolus asper*, Rooks county (Bartholomew). Proc. Acad. Nat. Sci., Phila., 1893, 155.

186. Æcidium cylindricum E. & E. On leaves of *Houstonia angustifolia*, Osborne county (C. L. Shear). Bull. Torr. Club, 1895, 61.

Sphæropsidæ (Dust Fungi).

187. Phyllosticta maculans Ell. & Everh. On fallen leaves of *Populus monilifera*, Rooks county (Bartholomew). Proc. Acad. Nat. Sci. Phila., 1893, p. 157.

188. Phyllosticta confertissima E. & E. On leaves of *Ulmus fulva*, Pottawatomie county (Bartholomew). L. c., 1895, 455.

189. Phyllosticta moricola E. & E. On seedling leaves of *Morus rubra*, Pottawatomie county (Bartholomew). L. c., 455.

190. Phoma viridis Ell. & Barth. On dead leaves of *Fraxinus viridis*, Rooks county, January, 1895 (Bartholomew). Erythea, 1896, p. 4.

191. Phoma ribis E. & B. On decorticated twigs of cultivated gooseberry, Rockport, March, 1895 (Bartholomew). L. c., p. 4.

192. Phoma biformis E. & B. On dead *Amorpha fruticosa*, Rooks county, March, 1896 (Bartholomew). L. c., 80.

193. Dothiorella concaviuscula E. & B. On dead branches of *Fraxinus viridis*, Rooks county, January, 1895 (Bartholomew). Erythea, 1896, 23.

194. Dothiorella negundinis E. & B. On bark of dead limbs of *Negundo aceroides*, August, 1894 (Bartholomew). L. c., 23.

195. Aposphæria amaranti E. & B. On dead stems of *Amarantus retroflexus*, Rockport (Bartholomew). L. c., p. 4.

196. Cytispora negundinis E. & E. On dead limbs of *Negundo aceroides*, Rockport (Bartholomew). Proc. Acad. Nat. Sci. Phila. 1894, 360.

197. Cytispora juglandicola E. & B. On bark of dead limbs of *Juglans nigra*, Rooks county, November, 1894 (Bartholomew). Erythea, 1896, p. 23.

198. Cytispora celastrina E. & B. On dead stems of *Celastrus scandens*, Rooks county, April, 1895 (Bartholomew). L. c., p. 80.

199. Cytispora gleditschiæ E. & B. On dead limbs of *Gleditschia triacanthos*, Rooks county, December, 1895 (Bartholomew). L. c., p. 80.

200. Sphæropsis vitigena E. & E. On dead shoots of cultivated grape-vines, Rockport (Bartholomew). Proc. Acad. Nat. Sci. Phila., 1893, 160.

201. Sphæropsis amorphæ E. & B. On dead branches of *Amorpha fruticosa*, Rooks county, December, 1894 (Bartholomew). Erythea, 1896, 23.

202. Sphæropsis robiniæ E. & B. On dead branches of *Robinia pseudacacia*, Stockton, November, 1895 (Bartholomew). L. c., 81.

203. Sphæropsis triacanthi E. & B. On dead limbs of *Gleditschia triacanthos*, Rooks county, December, 1895 (Bartholomew). L. c., 81.

204. Haplosporella velata E. & B. On dead stems of *Celastrus scandens*, Rooks county, January, 1895 (Bartholomew). Erythea, 1896, 24.

205. Haplosporella longipes E. & B. On dead branches of *Morus*, Rooks county, December, 1895 (Bartholomew). L. c., 81.

206. Haplosporella negundinis E. & B. On fallen limbs of *Negundo aceroides*, Rooks county, February, 1896 (Bartholomew). L. c., 81.

207. Diplodia kansensis E. & E. On bleached, weather-beaten bark of *Juniperus virginiana*, Rockport (Bartholomew). Proc. Acad. Nat. Sci. Phila. 1894, 363.

208. Diplodia celastrina E. & E. On dead stems of *Celastrus scandens*, Rooks county (Bartholomew). L. c., 1895, 432.

209. Diplodia lophiostomoides E. & B. On decorticated limbs of *Negundo aceroides*, Rooks county, July, 1895 (Bartholomew). Erythea, 1896, p. 24.

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210. Diplodia clavispora E. & B. On decaying wood of an old elm stump, Rooks county, May, 1894 (Bartholomew). L. c., 24.

211. Diplodia celtidigena E. & B. On fallen limbs of *Celtis occidentalis*, Phillips county, March, 1896 (Bartholomew). L. c., 82.

212. Diplodiella striispora E. & B. On decorticated cottonwood stump, Rooks county, January, 1894 (Bartholomew). L. c., 24.

213. Diplodina psoraleæ E. & B. On dead stems of *Psoralea tenuiflora*, Rooks county, December, 1893 (Bartholomew). L. c., 25.

214. Actinonema psoraleæ E. & E. On living leaves of *Psoralea digitata*, Rooks county (Bartholomew). Proc. Acad. Nat. Sci. Phila., 1893, 159.

215. Ascochyta rhei E. & E. On leaves of *Rheum rhaponticum*, Rockport (Bartholomew). L. c., 160.

216. Stagonospora strictæ E. & E. On leaves of *Carex stricta*, Rooks county (Bartholomew). L. c., 162.

217. Hendersonia staphylea E. & E. On *Euonymus atropurpureus*, Kansas (Kell. & Sw.) Proc. Acad. Nat. Sci. Phila., 1893, 162.

218. Hendersonia stygia E. & E. On decorticated bleached wood of a cottonwood log, Rooks county, December, 1893 (Bartholomew). L. c., 1894, 364.

219. Hendersonia pseudacaciæ E. & B. On dead limbs of *Robinia pseudacacia*, Rooks county, March, 1894 (Bartholomew). Erythea, 1896, 25.

220. Hendersonia fraxini E. & B. On dead limbs of *Fraxinus viridis*, Rooks ccunty, March, 1895 (Bartholomew). L. c., 26.

221. Camerosporium celtidis E. & E. On dead limbs of *Celtis occidentalis*, Rooks county (Bartholomew). Proc. Acad. Nat. Sci. Phila., 1894, 366.

222. Septoria purpureocincta E. & E. On leaves of *Prunus americana*, Rooks county (Bartholomew). L. c., 1893, 163.

223. Septoria aurea E. & E. On leaves of *Ribes aureum*, Rockport (Bartholomew). L. c., 163.

224. Septoria gaillardiæ E. & E. On leaves of *Gaillardia pulchella*, Rockport (Bartholomew). L. c., 164.

225. Septoria lepachidis E. & E. On leaves of *Lepachys columnaris*, Rockport (Bartholomew). L. c., 164.

226. Septoria gigaspora E. & E. On leaves of *Celtis occidentalis*, Rooks county (Bartholomew). L. c., 1895, 458.

227. Septoria alba E. & B. On living leaves of *Silphium integrifolium*, Rooks county, August, 1894 (Bartholomew). Erythea, 1896, 25.

228. Septoria rhabdocarpa E. & B. On fallen leaves of *Populus monilifera*, Rooks county, September, 1894 (Bartholomew). L. c., 25.

229. Septoria incarnata E. & B. On living leaves of *Asclepias incarnata*, Rooks county, July, 1894 (Bartholomew). L. c., 25.

230. Pestalozzia kansensis E. & B. On old dead leaves of *Quercus macrocarpa*, Rooks county, January, 1894 (Bartholomew). L. c., 26.

231. Pestalozzia œnotheræ E. & B. On dead stems of *Œnothera biennis*, Rooks county, March, 1895 (Bartholomew). L. c., 26.

232. Pestalozzia fibriseda E. & B. On weatherbeaten wood of *Rhus glabra*, Rooks county (Bartholomew). L. c., 27.

233. Labrella infuscans E. & B. On weather-beaten pine boards, Rooks county, March, 1894 (Bartholomew). L. c., 27.

Hyphomycetes (Mildews).

234. Cercospora crotonis E. & E. On leaves of *Croton texensis*, Rockport (Bartholomew). Proc. Acad. Nat. Sci. Phila., 1893, 170.

235. Cercospora ditissima E. & E. On leaves of *Cnicus undulatus*, Rockport (Bartholomew). L. c., 171.

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236. Cercospora melanochæta E. & E. On leaves of *Celastrus scandens*, Pottawatomie county, October, 1893 (Bartholomew). L. c., 1894, 380.

237. Cercospora didymospora E. & B. On capsules and leaves of *Œnothera fremontii*, Rooks county, July, 1894 (Bartholomew). Erythea, 1896, 28.

238. Cercospora physalicola E. & B. On living leaves of *Physalis virginica*, Rooks county, July, 1894 (Bartholomew). L. c., 28.

239. Cercosporella nivea E. & B. On living leaves of *Solidago radula*, Rooks county, September, 1895 (Bartholomew). L. c., 82.

240. Cladosporium aterimum E. & E. On rotton wood, Rockport, November, 1893 (Bartholomew). Proc. Acad. Nat. Sci. Phila., 1894, 378.

241. Cladosporium subsessile E. & B. On living stems of *Populus monilifera*, Rooks county, September, 1894 (Bartholomew). Erythea, 1896, pp. 27 and 83.

242. Macrosporium amaranthi Peck. On dead spots of leaves of *Amaranthus retroflexus*, Rooks county (Bartholomew). Bull. Torr. Bot. Club, 1895, 493.

243. Macrosporium clematidis Peck. On living or languishing leaves of *Clematis fremontii*, Kansas (Bartholomew). L. c., 493.

244. Macrosporium nelumbii E. & E. On leaves of *Nelumbium luteum*, Pottawatomie county (Bartholomew). Proc. Acad. Nat. Sci. Phila., 1895, 464.

245. Macrosporium panici E. & B. On living leaves of *Panicum virgatum*, Rooks county, July, 1894 (Bartholomew). Erythea, 1896, 28.

246. Macrosporium uredinis E. & B. On uredo of *Puccinia graminis* on "volunteer" oats, Rooks county, September, 1894 (Bartholomew). L. c., 28.

247. Coniosporium maydis E. & B. On old corn-stalks, Rooks county, July, 1895 (Bartholomew). L. c., 82.

248. Clasterosporium kansense E. & B. On under side of cottonwood post lying on the ground, Rockport, September, 1894 (Bartholomew). Erythea, 1896, 28.

249. Sporodesmium exasperatum E. & B. On the bottom of an oaken barrel in a cellar, Rooks county, May, 1894 (Bartholomew). L. c., 29.

250. Dendryphium curtipes E. & B. On the underside of an old hog trough, Rooks county, December, 1894 (Bartholomew). L. c., 82.

251. Volutella bartholomæi E. & E. On leaves of *Sporobolus asper*, Rockport (Bartholomew). Proc. Acad. Nat. Sci. Phila., 1893, 171.

It is not possible to tell exactly how many plants this makes for the State of Kansas, without making a new verified list. No doubt a good many plants are duplicated, owing to the uncertainty of determination, often, by students and other collectors, who sometimes reported plants that turned out to be something else. But, according to the best of our knowledge, the number of plants found in Kansas is as follows:

Catalogue of Prof. J. H. Carruth, of 1876, with additions up to 1884, 1,515 species, from which were deducted by Smyth, in 1890, on account of error or duplication, 145, leaving net	1,370
Fungi published by Cragin in Bull. Wash. Coll. Lab., 1884 to 1888, including 48 lichens published in Tuckerman's N. A. Fungi	373
Fungi published by Kellerman in Vol. X, Trans. Kan. Acad. Sci., 1886, (not counted in Cragin's lists)	266
Fungi published by Swingle in Vols. XI and XII, up to 1890	33
Plants published by other people, in various publications	48
Additions by Smyth, made in Vol. XII, 1890	447
Additions by Smyth in 1892 (Vol. XIII)	155
Additions by Smyth in 1894 (Vol. XIV)	27
Additional mosses by Miss Reed, in Vol. XIV, 1894	54
Additions in this list by Smyth, including a part of those published by Bartholomew and others, outside the state	251
Total to date	3,024

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The total number of species of flowering plants reported as found in the state is 1,997; and of cryptogamic plants of all kinds, including ferns, mosses, liverworts, lichens, algæ, and parasitic fungi, 1,027. Much more remains to be done; and with active botanical workers in the state, the chances are that before long there will be a greater list of veritable species reported from Kansas than from any other state, except California.

THE PROPAGATION OF ERYTHRONIUMS.

By E. B. KNERR, Atchison, Kan. Read before the Academy January 2, 1897.

Possibly none of our native flowering plants are more interesting than the Erythroniums, or dog-tooth violets or adder-tongues, as they are popularly known. Certainly none are more beautiful.

Along the bluffs of the Missouri river we find but two species — the Erythronium albidum and the Erythronium mesochoreum; however, in the woods about my Ohio home, I was familiar with the Erythronium americanum as well as Erythronium albidum.

In this paper I desire to present an account of the various modes of propagation by corms followed in the three species mentioned.

Whoever has studied botany is well aware of the fact that our native Erythroniums present two forms of plants — a two-leaved flowering form and a single-leaved sterile form. Now it is these sterile or flowerless forms which I have found so interesting, and which most writers in descriptive botany seem to have inexcusably overlooked, and to these I would especially direct attention at the present time.

In both Erythronium americanum or yellow adder-tongue of the East, and in E. albidum, the white dog-tooth violet of the Mississippi valley, the flowerless forms are exceedingly numerous, covering almost completely with a continuous mat of erect, glossy, richly-mottled leaves the sloping sides of the shaded ravines where they occur. The explanation for this wealth of vegetation is not far to seek. Carefully remove a specimen of the one-leaved form of the yellow adder-tongue from the rich leaf-mold in which it grows, and usually three or more offshoots will be observed to have taken their rise from the parent corm. These offshoots are quite brittle, and hence care must be exercised in taking up the plants. At the end of each shoot will be found a slight enlargement, which develops into a corm by the time the parent plant and runners have withered. These corms are capable of producing only one-leaved plants the next season. Thus, where this year appeared but one plant, next year in close proximity will spring up three and possibly four plants to represent it, provided that meanwhile some hungry wood-mouse, mole, grub or worm has not made a dinner of some of the young and tender, juicy corms. A peculiarity of the offshoots in E. americanum is that at first they are usually directed upward, so that they may even rise above ground; and then they bend gracefully over and again seek to enter the spongy leaf-mold, planting the terminal corm, sometimes after devious turnings and twistings, as much as 6 or 8 inches, or possibly 10, from the site of the parent plant. The advantage of new forage ground is thus gained for the progeny plants. Occasionally flowering forms will also be found whose corms throw out offshoots. Of course such corms will not flower next season, and will send up only single leaves because of their divided vitality. This fact explains

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why the yellow Erythronium seldom blooms the second season after being transplanted to a garden.

In Erythronium albidum we notice a similar feature of the sterile forms. However, in this species I have never found more than two offshoots to spring from each corm, and I have examined hundreds. Furthermore, the runners of E. albidum are first directed downward at an angle and then curve upward, finally planting the new corms, developed at the ends of the runners, at a distance of three to eight inches from the parent corm. This doubling of corms will soon mat a woodland hill slope. Seldom, however, will more than a single offshoot from a flowering corm be found; and then its displacement is not more than an inch or two, and most frequently is only the merest fraction of an inch, scarcely rupturing the old corm coat. In fact, the new corm for next year's growth is generally developed right at the base and to one side of the old corm. Because of this fact the corms in both albidum and americanum are seldom found in an erect position in the soil, but rather set at an angle, and even almost horizontal at times.

And now what is the meaning of all this? When, if ever, do these thousands of one-leaved dog-tooth violets and yellow adder-tongues bloom? What a glorious sight it would be if that whole shaded hill slope bordering the woodland creek should some spring day take a notion to bloom forth, each of the thousands of corms bearing its nodding bell of pink and white; or if that old Ohio ravine should just for one May day be a blaze of golden adder-tongues! Such thoughts would come to us in our boyhood days as we roamed those ravines in early spring for treasures for our herbariums, but no hopes for their realization had ever been seriously entertained, and we were content to search for the few stars in the fields of mottled green, which found, with what diligence did we ply the collector's trowel lest we should be so luckless as to cut off the delicate stem ere the deeply buried coveted corm was reached! But the puzzle of it all remained unsolved until we reached Kansas soil. Imagine our delight, then, when in the spring of 1890 we indeed did behold the hilltops ablaze with thousands of Erythroniums. What our boyhood dreams had visioned, and cool reason had denied as impossible, was here indeed a reality. Every plant bore a flower. Could this be our old friend, the Erythronium albidum of former days, here in Kansas under a clearer sky seeking a freer life? We thought not, and this Academy has already heard its announcement as Erythronium mesochoreum, a new species, at the Ottawa meeting, in 1891.

What interests us to-day is the fact that this species opens up the secret of propagation and flowering in the Erythroniums. Seeking out some of the one-leaved, flowerless forms (for indeed they will have to be sought for), and removing them with the utmost care from the ground, you will fail to find on them any runners whatever. Nor do the flowering forms bear runners or offsets. Instead, the new corms are developed at the base, a little to one side, and yet within the fold of the old corm. Furthermore, a well-established flowering plant will have a succession of corms within corms to the number of three or even four or five. This difference in the corm structure ought to account for the difference in flowering habits of the several species, and so it does.

But how came this difference in structure? We observed in both E. americanum and E. albidum that sometimes the flowering corms also gave rise to runners with secondary corms at their extremities. Such accidents in growth can only be explained by environment. The corms of E. americanum and E. albidum, growing in the easily yielding leaf-mold, find no difficulty in producing offshoots; and so long as such is their condition and position, they continue to

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divide their energies and produce a multitude of corms, none of which have sufficient material from which to build up a flowering stem. But let some of them be covered to a considerable depth with heavier soil, either by freshets or through other accident, and the propensity to throw off runners is at once checked; as a result, in a year or two sufficient nourishment is stored and vitality accumulated to send up two leaves instead of one and unfold from their embrace the prettiest of wild flowers. In evidence, the flowering forms will be found to always have their corms very much deeper than the sterile forms.

Erythronium mesochoreum, the form with the more slender and unmottled leaves, confirms this explanation. Appearing as it does some ten days or two weeks earlier than E. albidum, when as yet the woodland ravines are scarcely out of the icy grasp of winter, it must needs occupy more sunny ground. But in such position it must compete with other sun-loving plants that later in the season claim their day. For it there is no soft, spongy leaf-mold, as a rule, but the hard, close mat of sod above. To develop runners is out of the question; so each seedling as it wins a footing begins at once to push its bulb almost straight downward. Each year finds it a step lower and with all its vitality conserved, not divided, as in the case of its more easy-going sisters, albidum and americanum. Hence it is that before many years it has strength to bloom, and thus, coming more promptly to the flowering stage, the one-leaved forms of this species are comparatively rare.

A PROVISIONAL LIST OF THE FLOWERING PLANTS OF McPHERSON COUNTY.

By H. J. Harnly, McPherson, Kan. Read (by title) before the Academy January 2, 1897.

Believing that complete lists of the plants of many and widely distributed localities are essential to a complete knowledge of the flora of Kansas and its distribution, we venture to submit the following provisional list of the flowering plants of McPherson county. It is needless to say that the list is as yet far from complete. We hope to add to it from time to time. We are pleased to acknowledge the valued assistance of our some-time pupil, Mr. Claude Shirk, who has borne the burden of the work.

1. Ranunculaceæ.

1. Anemone patens.
2. Delphinium azureum.

2. Papaveraceæ.

3. Argemone platyceras.

3. Cruciferæ.

4. Sisymbrium canescens.
5. Brassica sinapistrum.
6. Capsella bursa-pastoris.
7. Lepidium virginicum.

4. Violaceæ.

8. Viola palmata.
9. Viola palmata var. cucullata.

5. Caryophyllaceæ.

10. Silene antirrhina.

6. Portulacaceæ.

11. Portulaca oleracea.

7. Malvaceæ.

12. Callirrhoe involucrata.
13. Callirrhoe digitata.
14. Malvastrum coccineum.
15. Hibiscus trionum.

8. Geraniaceæ.

16. Oxalis violacea.
17. Oxalis stricta.

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9. Vitaceæ.

18. Vitis cordifolia.

10. Rhamnaceæ.

19. Ceanothus ovatus.

11. Sapindaceæ.

20. Negundo aceroides.

12. Anacardiaceæ.

21. Rhus glabra.
22. Rhus toxicodendron.

13. Leguminosæ.

23. Baptisia leucophæa.
24. Baptisia australis.
25. Melilotus officinalis.
26. Melilotus alba.
27. Psoralea floribunda.
28. Psoralea esculenta.
29. Amorpha canescens.
30. Amorpha fruticosa.
31. Petalostemon violaceus.
32. Petalostemon candidus.
33. Tephrosia virginiana.
34. Astragalus caryocarpus.
35. Glycyrrhiza lepidota.
36. Vicia sativa.
37. Cassia chamæcrista.
38. Desmanthus brachylobus.
39. Schrankia uncinata.

14. Rosaceæ.

40. Prunus chicasa.
41. Prunus virginiana.
42. Geum album.
43. Rosa blanda setigera.

15. Saxifragaceæ.

44. Ribes rotundifolium.
45. Ribes gracile.

16. Lythraceæ.

46. Lythrum alatum.

17. Onagraceæ.

47. Œnothera biennis.
48. Œnothera sinuata.
49. Œnothera albicaulis.
50. Œnothera pumila.
51. Gaura biennis.
52. Gaura coccinea.

18. Cucurbitaceæ.

53. Cucurbita fœtidissima.

19. Ficoideæ.

54. Mollugo verticillata.

20. Umbelliferæ.

55. Peucedanum villosum.

21. Cornaceæ.

56. Cornus stolonifera.

22. Caprifoliaceæ.

57. Sambucus canadensis.
58. Symphoricarpos vulgaris.

23. Compositæ.

59. Vernonia baldwinii.
60. Eupatorium altissimum.
61. Eupatorium ageratoides.
62. Kuhnia eupatoroides var. corymbulosa.
63. Liatris cylindracea.
64. Solidago missouriensis.
65. Solidago rigida.
66. Erigeron canadensis.
67. Erigeron strigosus.
68. Gnaphalium polycephalum.
69. Gnaphalium uliginosum.
70. Ambrosia trifida.
71. Ambrosia artemisifolia.
72. Xanthium canadensis.
73. Lepachys columnaris.
74. Lepachys columnaris var. pulcherrima.
75. Helianthus annuus.
76. Helianthus petiolaris.
77. Helianthus grosse-serratus.
78. Helianthus maximiliani.
79. Coreopsis tinctoria.
80. Bidens cernua.
81. Bidens bipinnata.
82. Hymenopappus corymbosus.
83. Dysodia chrysanthemoides.
84. Achillea millefolium.
85. Chrysanthemum leucanthemum.
86. Senecio aureus.
87. Cnicus lanceolata.
88. Troximon cuspidatum.
89. Taraxacum officinale (dens-leonis).
90. Pyrropappus scaposus.
91. Lactuca canadensis.
92. Lactuca scariola.
93. Sonchus asper.

24. Campanulaceæ.

94. Specularia perfoliata.

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25. PRIMULACEÆ.

95. Androsace occidentalis.

26. APOCYNACEÆ.

96. Apocynum cannabinum.

27. ASCLEPIADACEÆ.

97. Asclepias tuberosa.
98. Asclepias purpurascens.
99. Asclepias verticillata.
100. Asclepias stenophylla.
101. Acerates longifolia.
102. Acerates lanuginosa.

28. BORRAGINACEÆ.

103. Lithospermum pilosum.
104. Lithospermum canescens.
105. Lithospermum hirtum.
106. Lithospermum angustifolium.
107. Lithospermum longiflorum.

29. CONVOLVULACEÆ.

108. Ipomœa purpurea.
109. Convolvulus (Calystegia) sepium.

30. SOLANACEÆ.

110. Solanum nigrum.
111. Solanum rostratum.
112. Physalis pubescens.
113. Physalis viscosa.
114. Physalis lanceolata.
115. Physalis pennsylvanica.
116. Datura stramonium.

31. SCROPHULARIACEÆ.

117. Verbascum thapsus.
118. Pentstemon cobœa.

32. OROBANCHACEÆ.

119. Aphyllon uniflorum.

33. VERBENACEÆ.

120. Verbena angustifolia.
121. Verbena stricta.
122. Verbena bipinnatifida.
123. Lippia lanceolata.
124. Lippia cuneifolia.

34. LABIATÆ.

125. Teucrium canadensis.
126. Salvia azurea.
127. Salvia lanceolata.
128. Scutellaria parvula.
129. Nepeta glechoma.

35. PLANTAGINACEÆ.

130. Plantago major.
131. Plantago lanceolata.

36. NYCTAGINACEÆ.

132. Oxybaphus nyctagineus.
133. Oxybaphus angustifolia.

37. AMARANTHACEÆ.

134. Amaranthus retroflexus.
135. Amaranthus chlorostachys.
136. Amaranthus albus.
137. Acnida tuberculata.

38. CHENOPODIACEÆ.

138. Chenopodium album.
139. Chenopodium hybridum.

39. PHYTOLACCACEÆ.

140. Phytolacca decandra.

40. POLYGONACEÆ.

141. Eriogonum annuum.
142. Rumex altissimus.
143. Rumex crispus.
144. Rumex obtusifolius.
145. Polygonum ramosissimum.
146. Polygonum lapathifolium.
147. Polygonum pennsylvanicum.
148. Polygonum convolvulus.

41. EUPHORBIACEÆ.

149. Euphorbia serpens.
150. Euphorbia hypericifolia.
151. Euphorbia glyptosperma.
152. Euphorbia maculata.
153. Euphorbia preslii.
154. Euphorbia marginata.
155. Euphorbia dentata.
156. Euphorbia obtusa.

42. URTICACEÆ.

157. Ulmus fulva.
158. Ulmus americana.

43. JUGLANDACEÆ.

159. Juglans nigra.

44. CUPULIFERÆ.

160. Quercus macrocarpa.

45. SALICACEÆ.

161. Salix alba.
162. Populus monilifera.

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46. IRIDACEÆ.

163. Sisyrhinchium bermudiana, var.

47. LILIACEÆ.

164. Allium cernuum.
165. Allium mutabile.
166. Allium vineale.
167. Nothoscordum striatum.
168. Androstephium violaceum.
169. Yucca angustifolia.

48. COMMELINACEÆ.

170. Tradescantia virginica.

49. ALISMACEÆ.

171. Sagittaria variabilis.

50. CYPERACEÆ.

172. Cyperus filiculmis.

51. GRAMINEÆ.

173. Setaria viridis.
174. Buchloe dactyloides.
175. Panicum glabrum.
176. Panicum sanguinale.
177. Panicum proliferum.
178. Panicum capillare.
179. Cenchrus tribuloides.
180. Aristida oligantha.
181. Aristida purpurea.
182. Eragrostis pectinacea spectabilis.
183. Elymus sitanion.

THE TIMBERED MOUNDS OF THE KAW RESERVATION.

By C. N. GOULD, Winfield, Kan. Read before the Academy December 31, 1896.

About three miles south of the territory line and eight miles south of Maple City, Kan., are situated several hills on which are located what are known locally as "The Timbered Mounds." They are situated some half mile east of the junction of Myers creek and Little Beaver.

The hills in all the region consist of massive ledges of limestone, containing much flint and alternating strata of gray and drab shale. Near the base of the hill the prominent ledge on both sides of the creek is the Strong flint of Prosser, beneath which is a ledge of massive sandstone. The ledge capping the hills is the Fort Riley or Florence flint. It is on the last-named ledge that the "Mounds" are located.

In some bygone age the region has doubtless been inhabited by a race who used these hills for some purpose. On a crescent-shaped ridge about a half a mile long and from 50 to 150 feet wide the hard but brittle limestone has been quarried in great quantities, and has apparently been piled up in the form of rude edifices, which have long since crumbled down. The stones which composed these buildings seem to have been broken out of the ledge at intervals and without regularity of size. In shape they are flat, not more than six inches thick, and usually longer than broad. There are none that a strong man cannot lift.

In certain areas of perhaps half an acre the loose rocks cover the ground to a depth of three to four feet. It is in these places, protected from fire, that a few dwarfed trees are growing. These trees—ash, elm, and hackberry—have given the name "Timbered Mounds" to the hills.

The edifices which have fallen down appear to have been either square or circular, with a ground diameter of from 5 to 15 feet. In several places can be noticed the faint outlines of structure, but usually the rocks are piled in shapeless heaps. One peculiarity is that so far as noticed all the buildings seem to have fallen toward the center as though they had sloped inward like an Esquimaux hut. Occasionally there will be a space in the center not covered with rock as if the wall was not high enough to reach the center when it fell. In several places along the brow of the hill are noticed a row of shapeless heaps of stone 8

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to 12 feet long containing apparently as much rock as could be drawn at two or three wagon-loads. Near each of these heaps is a quarry from which the rock forming the heap has been excavated. The quarry is from 1 to 3 feet deep, and usually 6 feet wide and 8 to 10 feet long.

No marks of tools have been discovered on the rocks; but in some places there are traces of fire. The quantity of rock quarried is great. It has been estimated that it would take 100 men six months to loosen the rock from its original position. Now if we remember that probably none but the rudest implements were used in the work, we will conclude that the time occupied was long. Beside the hill described there are at least four others, within a radius of three miles, covered with the same kind of ruins, and other hills with traces of the same peculiarities have been found in the state near Maple City.

Concerning the uses to which the rocks and edifices were put, we can only conjecture. There are at least five local theories advanced by the people in the vicinity, viz.: First, they are the sites of ancient mines. Second, the rocks were used as fortifications by warring tribes, and there is one tradition that the Spaniards were besieged here by the Indians. Third, they were residences. Fourth, they were used as places of religious ceremony. Fifth, they were places of burial.

The first four theories are hardly tenable for various causes: the fifth is possible. We may conjecture that tribes, camped between the bluffs in the valley below, near a large spring now known as Big Spring, buried their dead on the hilltops as do certain tribes to-day, notably the Osages, and as generation after generation died more rock was needed to erect more tombs, and in the course of time the great quantity which is now exposed was quarried. Human bones are said to have been found among the rocks, but this is not authentic.

Another theory, suggested by Dr. S. W. Williston, to whom this paper was shown, and which seems to the writer to be the most probable of all, is, that the ruins mark the sites of ancient flint quarries. The ledge on the top of the hill contains many flint nodules, sometimes nearly as large as a man's head, and among the loose rock these nodules are conspicuous for their absence, although many flakes of flint as large as one's hand may be found. This ledge is the furthest west of any flint-bearing ledge in the region; and probably the plains tribes from the west obtained their arrowheads and flint implements from this locality. This is further substantiated by the fact that the flint implements found in the prehistoric mounds at Arkansas City, some 20 miles northwest, contained fossil *Fusilina cylindrica*, which are characteristic of the flint mentioned. The edifices described above were probably temporary structures used by the workmen while engaged in quarrying. It is highly probable that systematic excavation would throw light on the subject.

PREHISTORIC MOUNDS IN COWLEY COUNTY.

By C. N. Gould, Winfield, Kan. Read before the Academy January 1, 1897.

For several years a number of people in and around Arkansas City have known of the presence of some so-called Indian mounds east of the city; but, until recently, no attempt has been made at systematic excavation. The mounds, about a dozen in number, are situated on the bluffs east of the Walnut river, and about a hundred feet above the stream. Looking west, a good view is obtained of the city, the Walnut valley, and the range of bluffs to the north and west.

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To the east the landscape, dotted here and there with farmhouses, stretches in gentle undulations until lost from view beyond the hills of Grouse creek.

Geologically, the mounds are situated on the highest massive limestone in the Permian of the region, probably referable to the Pleurophorus limestone of Prosser.

On December 21, 1896, a party composed of members of the Cowley County Historical Society drove from Winfield to the mounds for the purpose of making investigations. The investigations were confined to three mounds, and a number of valuable relics were found. The mounds, which have been greatly worn down, are circular in shape, from 20 to 30 feet in diameter, and from 2 to 5 feet high in the center. At the depth of from 1 to 3 feet from the surface, fragments of charcoal began to be found; these increase with the depth, until at from 4 to 10 feet deep, the soil is in a great measure replaced by charcoal and ashes. Intermingled with this charcoal are found broken pieces of pottery, apparently formed of broken shells mixed with clay and baked. No entire vessels have been found; but, judging from the fragments, they were shaped like a deep tin wash-basin, probably 6 inches deep and 10 to 12 inches in diameter. Several handles resembling those of a jug were found. The pottery is usually blackened with fire on one side, showing that it has been used.

Besides pottery were found a number of implements, including stone hammers and axes, mortars for grinding grain, flattened stones for dressing skins, flint arrow-heads and axes, and grooved stones, apparently for sharpening instruments, numerous flakes of flint, also two species of *Unio*, the bones of the following mammals: buffalo, elk, deer, rabbit, two species of mice, coyote, together with remains of tortoise, a gallinaceous bird, and fish.

Scattered over the mounds were a great quantity of Tertiary pebbles, which are not found nearer than the Arkansas river, three miles distant.

A few years since a cellar was dug on the site of one of these mounds, and a gentleman informed us that a half bushel of stone axes were thrown out in the loose dirt and carried away by people in the vicinity. It is to be regretted that these relics, which are of no little scientific value, should be lost by those who have so little appreciation of their importance.

BARITE NODULES IN WOOD.

By E. B. KNERR, Atchison, Kan. Read before the Academy December 31, 1896.

In digging a well during the summer of 1896 near Midland College, the workmen brought up some bits of wood from a depth of 40 feet. A peculiarity in the wood was the presence of many little white spheres, ranging from a thirty-second to an eighth of an inch in diameter. The material was crystalline in structure, the crystals radiating from the centers of the spheres, and chemical analysis proved it to be barite. The appearance of the wood fibers is as if they had been formed around the spheres. Whatever was the occasion of the peculiar growth, evidently the barite was a subsequent deposit in the cavities.

A careful separation of the material, to get it as pure as possible, gave the following analysis:

SiO_2 and gangue	4.00	per cent.
SO_3	33.25	"
BaO	62.17	"
CaO	.50	"
Total	99.92	per cent.

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Subtracting the silica and gangue, and recalculating, the following per cents. are obtained:

SO_3	34.64	per cent.
BaO	64.76	"
CaO	.50	"
Total	99.90	per cent.

The theoretical composition of barite is:

SO_3	34.33	per cent.
BaO	65.67	"
Total	100.00	per cent.

The specific gravity of the nodules was 4.55; color, ash white.

ON THE ALKYL HYPOBROMITES. R - O - Br.

F. W. Bushong, Emporia, Kan. Read before the Academy December 31, 1896.

About 10 years ago Sandmeyer first prepared and described * methyl hypochlorite and ethyl hypochlorite, but, possibly on account of their unstable and explosive nature, no further attempts were made to use them in the synthesis of other compounds.

In a study of cyanimidomethylcarbonate † and other imidoethers, undertaken about two years ago at the suggestion of Dr. J. U. Nef, these alkyl hypochlorites proved to be very valuable. Since the acid bromides are frequently much more reactive than the acid chlorides, it was to be expected that the alkyl hypobromites would be much more valuable reagents than the corresponding hypochlorites. Experiments were therefore begun in the hope of preparing such hypobromites.

Ethyl Hypobromite. $C_2H_5 - O - Br$.

Several attempts to prepare ethyl hypobromite from alcohol and hypobromous acid, prepared in the usual way from oxide of mercury and bromine, failed.

Fifty g. potassium bromide, 25 g. caustic soda and 25 g. alcohol were then dissolved in 250 c. c. water, and put into a wide thin-walled inner tube of a glass condenser, which was closed below by a three-way stopcock. Ice-water was kept flowing through the apparatus, and the temperature of the solution thus kept below -5° C. Washed chlorine gas, free from air, was passed in through the stopcock, the apparatus being inclined at an angle of about 15° from the horizontal, so that the bubbles would rise slowly through the liquid. ‡ As the bubbles of chlorine diminished in size through absorption, small globules of a red oil grew beneath them. This oil formed a layer at the bottom, but decomposed before it could be removed from the apparatus, although if left there undisturbed and kept cold it could be kept nearly half an hour.

Ethyl hypochlorite, which floats on water, was shaken up with a dilute solution of potassium bromide, which was kept below -8° C. Drops of ethyl hypobromite collected at the bottom, but exploded instantly, though not violently, when the mother-solution was poured off. A number of schemes were tried in order to weigh a portion for analysis, but none were successful.

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* Bericht d. deutsch. chem. Ges. 19, 857.

† cf. Nef, Cyanimidoethylcarbonate, Liebig's Ann. 287, 274.

‡ Sandmeyer, loc. cit.

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METHYL HYPOBROMITE. CH_3-O-Br.

A solution of 50 g. potassium bromide and 25 g. caustic soda in 25 c. c. methyl alcohol and 250 c. c. water was placed in the condenser previously described, and chlorine passed in as before, but no oil separated.

Methyl hypochlorite was then prepared and distilled into a dilute solution of potassium bromide, which was kept below -8° C. A drop of red oil would form at the end of the delivery tube and sink to the bottom, where it would soon begin to decompose, and then rise to the surface, where it would explode instantly.

It was evident from these experiments that ethyl hypobromite is more stable than methyl hypobromite. One would naturally conclude that the higher members of the series would be still more stable.

AMYL HYPOCHLORITE. $C_5H_{11}-O-Cl$.

Amyl alcohol was shaken up with a solution of 3 g. caustic soda in 300 cc. water, and after allowing the undissolved alcohol to separate the solution was put in the condenser and treated with chlorine. A layer of amyl hypochlorite was obtained. It resembles methyl and ethyl hypochlorites in being a green oil which floats on water and in having a sharp odor more disagreeable than that of chlorine gas, but it is more stable. While I was never able to keep either methyl or ethyl hypochlorites more than four hours, even when kept cold by freezing mixtures, I succeeded in keeping a sample of amyl hypochlorite in an open test-tube 24 hours, at the ordinary laboratory temperature in June. An attempt was made to distill a portion, but when heated to 75° C. it rapidly decomposed, with great evolution of heat and a strong odor of valerianic acid.

AMYL HYPOBROMITE. $C_5H_{11}-O-Br$.

Amyl hypochlorite was shaken up with a cold dilute solution of potassium bromide, and a layer of red oil sank to the bottom. It was washed by running cold distilled water through the vessel containing it, and a portion was then removed by means of a pipette, and weighed, and immediately plunged into dilute ammonia, where it very slowly decomposed. The haloids were precipitated by silver nitrate. 0.1987 g. oil gave 0.1688 g. silver haloids, which lost on heating in chlorine 0.0160 g., indicating that the oil may have been a mixture of amyl hypochlorite, amyl hypobromite and amyl alcohol or decomposition products. A loss of bromine was noticed at the time of transfer for weighing, this having been done in the extremely unfavorable weather of July. I expect to continue these experiments in cold weather, and feel confident that I can prepare alkyl hypobromites entirely free from chlorine, and make perfectly reliable analyses of them. I expect then to study their action on the isocyanides and other unsaturated compounds.

KANSAS MINERAL WATER.

By H. E. DAVIES, Lawrence, Kan.

Presented by E. H. S. Bailey, Lawrence, Kan., and read (by title) January 2, 1897.

Pure water is an artificial product of the laboratory. Natural waters always contain foreign matter in solution and suspension, varying in amount from a mere trace to a very large proportion. The properties, effects and uses of water are considerably modified by these ingredients, and the object in the investigation was to ascertain the chemical composition of some natural waters from different sections of the state.

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We may divide all natural waters into four classes:

1. Rain-water.
2. Surface-water, including streams and lakes.
3. Ground-water, including wells.
4. Deep water — water accumulated at considerable depth below the surface, such as artesian wells and springs.

Water containing a large amount of dissolved substances is not considered good for public supply, yet a small amount is considered of value. The presence of substances which ordinarily exist in solution in natural water is not regarded as necessary, because experience has shown that distilled water, properly aerated, is perfectly wholesome. It is, however, true that a person who is in the habit of drinking soft water generally experiences some derangement of the digestive organs on beginning to use distilled water. It has also been proven that the system needs salts of lime for the development of the bones of the body, and that these salts exist in the water; consequently, distilled water would not be so beneficial to the human system as comparatively hard water would be. Surface-waters containing vegetable matter are unhealthy, causing diarrhea, and other diseases, such as malaria and fevers. The most dangerous effects are believed to come from waters polluted with waste materials from large dwellings or sewage of towns and cities.

The "germ theory" of disease is that many diseases are due to the presence and propagation in the system of minute organisms, which are termed bacteria, and that some of the diseases which have their cause in such organisms are malarial fever, typhoid fever, diphtheria, and tuberculosis. Admitting the presence of these organisms in the bodies of persons sick with certain diseases — organisms which, at least in certain stages of their development, can exist outside the human body and retain their vitality for a long time — the question arises how they can find their way into the system of healthy persons to produce disease. The two most obvious of possible carriers of diseases are the air we breathe and the water we drink. Filtering cannot be relied upon in all cases. It has been known to fail utterly in the examination of the most contaminated reservoir water; even the best filters available will not keep back the smallest cell forms, sometimes very abundant. The small protococcus cells have been found in great numbers in waters filtered through sand, silica, or even filter paper. Fortunately, however, these forms are not common in waters. Professor Mallet, in regard to his idea on disease, says:

"If the theory be accepted which has so much in its favor, attributing the production of disease to organic matter in drinking-water — not to say specifically a poisonous substance or substances, but to the presence and actions of organic organisms — it seems quite conceivable that a water containing organic matter of any kind, including vegetable matter, may be harmless at one time, and harmful at another, when perhaps a different stage of fermentation or putrefactive change may have been entered upon and special organisms may have made their appearance or entered upon a new phase of existence. Thus, there might possibly be safety in drinking a peaty water, or water filtered through beds of dead forest leaves, when fresh; danger when, after a certain amount of atmospheric exposure, bacterial organisms had become developed; and safety again, perhaps, after the growth of such organisms had fallen off and more or less of the available organic matter had been consumed."

Though views may differ, we shall be safe in accepting the following summary as given in Nichols on "Water-supply":

1. "A water suitable for domestic supply must be free from all substances

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which are known to produce an injurious effect on the human system, or which are suspected with good reason, or on good authority, to produce such an effect.

2. "The water should be, as far as practicable, free from all substances and from all associations which offend the general æsthetic sense of the community, and thus affect the system through the imagination, even if there is good reason to suppose that it is within itself perfectly harmless."

Without doubt the best kind of water for drinking purposes is the moderately soft spring water, without any possibility of contamination by organic matter. Unfortunately, however, such water is hardly ever found in sufficient quantities for the supply of large cities.

Water Analysis.

Collection of Samples of Water.—The quantity of water which should be collected for analysis should not be less than a gallon, but in case of necessity a smaller amount will do. In collecting water, cleanliness should be insisted upon in all cases; the bottle or jar should be thoroughly washed out with weak sulfuric acid, then thoroughly rinsed with the same kind of water that is to be analyzed, and before collecting the water to be analyzed the collector should satisfy himself with the fact that there is no acidity left in the bottle from the acid used in cleaning it. After the bottle is sealed it should be immediately shipped to the analyst, in order that an examination be made of the substances that are liable to change by standing.

Total Solids.—The determination of total solids is made by evaporating a certain quantity of water in a weighed platinum dish and heating to 130° C. After the water is all driven off, the residue is weighed with the dish; the difference in weight of the dish and of the dish plus the residue gives the amount of total solids in the water.

Chlorine.—Chlorine usually occurs in water in combination with sodium; also, in small quantities with potassium, calcium, and magnesium. The amount of chlorine in water is not of a very great consequence, but the determination of chlorine is resorted to by chemists in order that they may be able to tell whether a certain water is contaminated with organic matter or not.

The determination of chlorine is made by the use of a standardized solution of silver nitrate.

There are some precautions to be guarded against in making this determination: the chromate should be perfectly neutral and free from chlorides; the silver solution and the water should also be perfectly neutral. The reason that acidity should be guarded against is because chromate of silver is soluble in acids.

A special method for the determination of the bases has been prepared by Prof. E. H. S. Bailey, and was used in these examinations. The method, with few additional suggestions obtained by experience in working with the above waters, is as follows: Determination of silica and insoluble residue, and of iron, aluminum, and phosphoric acid.

Silica and Insoluble Residue.—Acidulate one liter of the water with HCl, evaporate to dryness on a water-bath, heat the residue to 110° C, digest the residue with HCl, sufficient quantity to moisten it well, add hot water, and filter; the residue upon the filter is dried, ignited, weighed and calculated as insoluble residue and silica.

Iron, Aluminum, and Phosphoric Acid.—The filtrate from the preceding is treated with ammonium chloride and ammonium hydrate. After heating and allowing to settle, filter and wash. If the precipitate is very large it is redissolved in HCl and precipitated again with ammonium hydrate; the precipitate is then filtered out, dried, ignited and weighed as Al_2O_3, Fe_2O_3, and phosphoric acid.

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Determination of Lime.—The filtrate from the above is treated with ammonium oxalate, boiled, allowed to remain in a warm place for several hours, then filtered, washed, and the residue dried, ignited, and weighed either as carbonate or oxide.

Determination of Magnesium.—The filtrate from the above is evaporated to dryness with some nitric acid. If the residue is very large it is redissolved in nitric acid on an iron plate; then the residue is treated with cold water and a drop of HCl; filter if necessary, and add to the solution hydro-di-sodium phosphate and ammonium hydrate and allow the precipitate to stand several hours. The precipitate of ammonium-magnesium phosphate thus obtained is washed with dilute ammonia, and after drying is weighed as magnesium pyrophosphate.

Determination of Sulfuric Acid.—Acidulate one liter of water with HCl, and concentrate to about 200 c. c., add $BaCl_2$ and allow to stand for some time in a warm place. The $BaSO_4$ is weighed as such, and the sulfuric anhydride is calculated from this.

Determination of Na_2O, K_2O, and Li_2O.—The filtrate from the barium sulphate is evaporated to dryness in a platinum dish to remove HCl and separate silica. Digest the residue with a few c. c. of water, and precipitate magnesium without previous filtration by addition of a solution of Ba $(OH)_2$, avoiding a large excess. Enough has been added if a pellicle of barium carbonate forms upon the surface of the liquid on exposure a short time to the air. Filter and wash the usually slight precipitate; heat the filtrate, and add ammonium carbonate, and evaporate the filtrate to dryness, and remove by heating the ammonium chloride completely. Dissolve the sodium chloride in the residue with four or five c. c. of water; warm, and add a few drops of ammonium carbonate and ammonia to separate possible remaining traces of barium, magnesium, and calcium; filter again into a weighed platinum dish, evaporate to dryness, heat nearly to fusion, and weigh the mixed chlorides. Their residue will contain, besides sodium chloride, the potassium chloride, if any is present in the water. If enough alkali is obtained, it may, after weighing, be examined for potassium by ordinary methods.

Determination of Sodium Carbonate.—Evaporate one liter of the water to dryness on a water-bath, treat with water, filter, wash until filtrate no longer shows an alkaline reaction with litmus paper, and titrate the solution with standardized sulfuric acid. The result is calculated to sodium carbonate.

Determination of Bromine and Iodine.—These were determined according to the method as given in the *Journal of the American Chemical Society*, Vol. 18, August, 1896, page 688. This is a modified method, and the writer used it with good success.

A number of waters have been examined by the above methods. The most important of these are the following:

I.

Water from Girard, Kan., used as a source of city supply (parts per 100,000):

SiO_2, etc	1.75
$Fe_2O_3 + Al_2O_3$	.25
CaO	12.55
MgO	5.70
Na_2O	38.75
Na_2CO_3	1.43
SO_3	30.68
Cl	40.25
CO_2, undetermined.	

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These constituents are probably combined in the total solid residue, as follows:

SiO_2	1.75
Fe_2O_3	.25
$MgSO_4$	17.115
$CaSO_4$	24.863
Na_2CO_3	1.426
NaCl	66.327
Na_2SO_4	8.245
$CaCO_3$	4.125

II.

OVERBROOK, KAN.—This water was obtained from a well 144 feet deep, but water was reached when the well was dug down to 122 feet. On account of the large amount of salt in the water, vessels become covered with an incrustation when left standing in the water. This well is located 3 miles south and 1½ miles east of Overbrook, in Osage county. There are other wells within a mile of this which are deeper and the water is considerably softer. The constituents, estimated in parts per 100,000, are:

SiO_2 and insoluble residue	5.48
Fe_2O_3 and Al_2O_3	1.72
CaO	60.04
MgO	5.96
Na_2O	211.86
Na_2CO_3	2.85
SO_3	78.72
Cl	242.20
CO_2	undetermined.

In the mineral residue these constituents are probably combined thus (parts per 100,000):

SiO_2	5.48
Fe_2O_3	1.72
$MgSO_4$	17.88
$CaSO_4$	113.028
$CaCO_3$	24.107
Na_2CO_3	2.852
NaCl	399.118

III.

FREDONIA, KAN.—This water comes from a well that was bored for gas and oil, and is a good producer. It is about 700 feet deep. The water is essentially a brine, but it is interesting from the fact that it contains bromides and iodides. (Parts per 100,000.)

SiO_2 and insoluble residue	4.34
Fe_2O_3 and Al_2O_3	8.01
CaO	199.44
MgO	474.06
Na_2O	3746.20
Na_2CO_3	2.61
SO_3	3.14
Cl	4928.50
Br	7.90
I	.84

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These constituents are probably combined thus (parts per 100,000):

SiO_2	4.34
Fe_2O_3	8.01
$CaSO_4$	5.338
$CaCl_2$	394.610
$MgCl_2$	1123.465
Na_2CO_3	2.609
NaCl	7051.332
NaBr	10.165
NaI	1.060

IV.

WALTON.—This water is from a well near Walton that has obtained considerable local repute, as being of medicinal value. (Parts per 100,000.)

SiO_2 and insoluble residue	7.40
Fe_2O_3 and Al_2O_3	3.26
CaO	137.00
MgO	10.66
Na_2O	1.41
Na_2CO_3	0.53
SO_3	95.06
Cl	1.98
CO_2	undetermined.

These constituents are probably combined thus (parts per 100,000):

Insoluble residue	7.4
Fe, Al, etc	3.26
$CaCO_3$	38.84
Na_2CO_3	0.53
$MgSO_4$	31.977
NaCl	2.650
$CaSO_4$	139.123

V.

ST. PAUL.—This water is from a deep well. It is practically a brine. The constituents are as follows (parts per 100,000):

SiO_2 and insoluble residue	1.70
Fe_2O_3 and Al_2O_3	7.10
CaO	65.14
MgO	56.84
Na_2O	1455.54
Na_2CO_3	4.77
SO_3	1.87
Cl	1712.40
CO_2, undetermined.	

If properly combined, the results would be (parts per 100,000):

Insoluble residue	1.70
Fe_2O_3, Al, etc	7.10
$CaCO_3$	113.945
$CaSO_4$	3.175
$MgCl_2$	134.701
Na_2CO_3	4.770
NaCl	2742.000

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While a good knowledge of the composition of the normal waters of any region is of the greatest value in the interpretation of an analysis, it is claimed "there is no good basis for the establishment of fixed limits for all the various items of analysis below which a water is to be pronounced good and above which it is to be condemned." The value of an analysis, or the opinion of the analyst, about a certain water which has been examined by him, does not depend upon the fullness of his work alone, but also upon the amount of his knowledge concerning the conditions that surround the water. It is not, however, an easy matter to obtain a good knowledge of its surroundings, and on this account the value of the opinion of the analyst is not of so much value. It is better to take the advice of the analyst according to his experience and reputation, rather than to try and obtain an unbiased opinion by withdrawing facts necessary for a satisfactory judgment.

ATCHISON AND NEMAHA COUNTY MINERAL WATERS.

By E. B. Knerr, Atchison, Kan. Read before the Academy January 2, 1897.

The drift in Atchison county is quite uniform in structure, being a heavy compact clay for the most part, with but little gravel and sand intermixed. Water will pass through it very slowly; hence, the wells dug into it are deep, as a rule, usually from 40 to 60 feet in depth; and the water generally stands quite low, though about three feet of water may generally be counted upon in the dryest months. Such wells at those seasons may be easily be pumped dry, but in the course of several hours the water will collect to the depth of a foot or two again. Analysis of this drift water presents nothing of unusual interest.

There are numerous springs in Atchison county. Where these issue from the limestone they are of interest only as furnishing good, cool drinking-water. Several such springs occur within the city limits of Atchison, and have always supplied the neighborhoods in their immediate vicinity with water. One of these springs had for years enjoyed a reputation for medicinal virtues. I was sufficiently interested to make an analysis of its waters, with the following results, which, however, do not reveal, so far as I could discover, any unusual therapeutic qualities (parts per 1,000,000):

NO	Trace
NO_3	79.0
SiO_2	30.0
SO_3	97.0
CO_3	217.0
Cl	58.0
Basic oxygen	133.0
Fe	6.0
Al	Trace
Ca	156.0
Mg	25.0
K	6.0
Na	111.0
NH_4	Trace
P_2O_5	4.0
Total solids	922.0

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The presence of nitrites, nitrates, phosphates, and chlorides made me suspect that possibly the water was contaminated with surface or sewage waters. This suspicion was confirmed when a day after a heavy rain the flow of water was perceptibly increased.

However, when the springs issue from shale beds they are usually weaker in flow, and the waters leave a stain of iron along their course, and at times show a slight iridescent film on their surface.

When wells are put down about Atchison to a depth of 200 to 300 feet, the water obtained is salty. In the western part of the city, in part of Mr. Peter Becker's property on West Main street, there is such a well 325 feet deep. The water from this well is too salty to drink. When first drawn it is surcharged with carbon dioxide gas, and is perfectly clear. But as the gas escapes the water becomes turbid with a precipitate of iron oxide. The analysis of this water stated in parts per 1,000,000 resulted as follows:

SiO_2	18.0
SO_3	924.0
CO_2	435.7
P_2O_5	18.0
Cl	15550.0
Basic O	415.0
Fe and Al	42.0
Ca	420.0
Mg	310.0
K	36.0
Na	10100.0
NH_4	20.0
Total solids	28298.7

About 2½ miles north of Centralia, in Nemaha county, is a well 125 feet deep, the water of which is highly charged with sulphate of lime. Whether this argues gypsum deposits at that depth we will not state. The analysis of the water is as follows, stated in parts per 1,000,000:

SiO_2	25.0
SO_3	1625.5
CO_2	634.1
Cl	36.0
Basic O	306.0
Fe	2.8
Al	3.7
Ca	494.0
Mg	156.7
K	25.0
Na	31.5
NH_4	1.4
NO	4.2
NO_2	9.9
P_2O_5	46.8
Total solids	3402.6

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THE PLEISTOCENE OF KANSAS.

By S. W. WILLISTON, Lawrence, Kan. Read before the Academy December 31, 1896.

Following the terminology of Dana, the Pleistocene of America has two well-defined periods, the Glacial and the Champlain; the former characterized by the prevalence of glacial conditions, the latter by fluvial, by an ameliorated climate, luxuriant forest growths, and more or less submergence. The third period of the Quaternary, the Recent, is characterized by a partial return to the colder climate, the elevation of the land, the development of the prairies, and a drier climate. It is precisely at this time, that of the change from the warmer and moister climate to the colder and drier one, that we would expect the culmination of the more susceptible forms of life and rapid change in the flora and fauna. Cope has already called attention to this change in an article that I will quote from further on. Every additional fact furnished from Kansas seems to substantiate his conclusions that the Megalonyx fauna of the east and the Equus fauna of the west were contemporaneous, and that both occurred during a period of depression — that is, during the late Pleistocene time. It is strange that some writers should still follow Marsh in his location of the Equus fauna in the Pliocene. That Marsh does so is not surprising; since, as Hatcher has shown, he has confounded the Loup Fork and Equus faunas in part, and seems to be unaware of recent publications on the subject.

That there was a depression in Kansas during Champlain times is certain. That this depression was considerable, I do not believe, inasmuch as the river terraces in the eastern part of the state nowhere exceed 20 feet in total height.

"The Equus beds are always to be distinguished by the presence of Elephas primigenius, when other forms less easily preserved are not recognized." * This species is the most common fossil, or at least the one of which we have the most knowledge, in the Quaternary deposits of the state, and is the most widely distributed; and the conclusion is, hence, that the Equus beds are the prevailing superficial deposits of the state, a conclusion borne out by the other vertebrate fossils that are known. That all of the forms given below were contemporaneous, is, of course, not yet proven; but I believe that they were.

Cragin, in a recent paper,† has given a preliminary notice of three terranes in Clark county, which he wrongly ascribes to the late Pliocene. The lithological characters of these terranes are, of course, nearly worthless, save for local use; and he has not yet given a critical list of the vertebrate fossils contained in them. The lowermost of these, which he calls the Meade gravels, contained "abundant remains of horses, llamas, elephants, turtles," etc., some of which are "Elephas imperator (?), Megalonyx leidyi, Equus complicatus, E. curvidens, Auchenia huerfanensis," etc. Lying upon this terrane are volcanic ash-beds, which he calls the "Pearlette beds," and upon the ash-beds are the "Kingsdown marls, consisting of yellowish-brown, lacustrine, or slack-water marls, containing variously shaped concretions of carbonate or silicate of lime." All these terranes he locates in the Equus beds of Cope. It seems to me that further and more careful study of the fossils is desirable before we assume as certain that the late Pleistocene in Kansas reached the great thickness of over 250 feet.

The following list includes all the species of vertebrate fossils found in the Kansas Pleistocene of which I have any knowledge:

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* Cope, Vert. Pal. Llan. Estac., p. 75.

† Colorado College Studies, vol. 6, p. 53.

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Homo sapiens.
Mastodon americanus.
Elephas primigenius.
Elephas imperator (?) (Cragin).
Bison americanus.
Bison antiquus.
Bison crampianus.
Bison alleni.
Alces, species indet.
Equus major.
Equus excelsus.
Equus occidentalis.
Equus complicatus (Cragin).
Equus curvidens (Cragin).
Platygonus compressus.
Camelops Kansanus.
Auchenia huerfanensis.
Camelids, species indet.
Megalonyx leidyi.
Mylodon (?), species indet.
Canis lupus.
Canis, species indet.
Geomys bursarius.

HOMO SAPIENS: The contemporaneity of man with the Equus fauna is, I think, assured by the discovery of arrow-heads associated with the remains of *Bison antiquus*, in Gove county, by Mr. H. T. Martin.

MASTODON AMERICANUS: This species is rather rare in Kansas. An excellent pair of jaws was discovered some years ago in the alluvium of the Wakarusa valley, near Lawrence, and I have further knowledge of the same species from Manhattan and Jewell county. Reputed discoveries of this mastodon are not always to be trusted, since it is commonly confounded with *Elephas primigenius*.

ELEPHAS PRIMIGENIUS: This species has been found in nearly all parts of the state, but occurs most frequently in the western and southern parts, and yet more frequently in the Indian Territory south of Kansas. Three years ago an extraordinary deposit was discovered in Lane county, in the valley of the Smoky Hill, by Mr. Chas. Sternberg, the veteran collector of Kansas. From a small area, not more than two or three rods in diameter, portions of a score or more of these animals were obtained, together with others of *Equus excelsus* and of a small dog. Some seventy or more of the teeth are now in the University collection. The deposit was in a basin in a small ravine that had been hollowed out of the Niobrara chalk, and considerably below the Loup Fork beds, which here yielded teeth of *Protohippus placidus*. In the vicinity, and from a higher horizon, were obtained teeth of *Protohippus lenticularis*, a typical Goodnight beds species. There can be no question of the local character of the Elephas deposit. Everything indicates that the spot was the site of some old spring to which the different animals had come and died.

A large series of *Elephas primigenius* bones were obtained from the reddish alluvium of Clark county.

BISON AMERICANUS: Teeth agreeing quite with this species were obtained some years ago from 8 or 10 feet below the surface in the alluvium of the Wakarusa valley. There is also a jaw of this species in the collection from the southern part of the state bearing this label: "Found on strip pit (coal), on S. L. Cherry's place, in blue-muck clay and on top of the coal, six or seven feet from the surface." A while ago, Professor Hay sent to me for examination a part of a skeleton from the western part of the state, partly fossilized, and which Hay thought to have been contemporary with extinct species.

BISON ANTIQUUS: The only known occurrence of this species is in Gove county, in the valley of the Smoky Hill, where Mr. H. T. Martin obtained for our museum a complete skeleton, which will be mounted. The material in which the skeleton was found was quite like that of the Elephas and Platygonus deposits not far distant. As already stated, with these specimens was found an arrow-head, well fashioned, but small.

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BISON CRAMPIANUS: This species was described by Cope from a part of a skull found near Wellington, associated with *Elephas primigenius*.

BISON ALLENI: This species was described from a specimen found in the Blue river at Manhattan. The description is meager. The horizon is located in the "lower Pliocene." Upon what evidence I know not, as the specimen was purchased by myself from the finder of it.

ALCES, species indet: An extinct species of moose or an allied animal is represented by maxillary and mandibular bones in the University collection. There is no record of the collector, though I doubt not that they were obtained by Judge West, who rarely attached his name to the specimens in the collection. They have the following label, in Judge West's handwriting: "From the loess near Kansas City, 50 feet from the surface," and are accompanied by several skulls of *Geomys bursarius*, all of which are inclosed in an exceedingly hard matrix. Possibly the moose is Cervalces americanus, of which I can find no adequate description of the dentition. The teeth are larger than are the largest specimens of the living moose in our collection, obtained by Professor Dyche. The upper molars differ, especially in the presence of a prominent tooth-like process or projection near the base of the premolars on the outer side posteriorly, and which incloses a cavity between it and the tooth. It is largest on the second premolar, and is represented by a rudiment on the first true molar at the base of the strong middle column. In addition, the second and third premolars differ markedly in the much stouter anterior column exteriorly, which is dilated and turned backwards, and which would give, when worn, a T-shaped surface. The first and second upper molars have a small, tooth-like process in the valley internally. If the species is not C. americanus, it must be distinct from any hitherto described.

EQUUS MAJOR: So far as I am aware, the only occurrence of this species in Kansas is from the vicinity of McPherson, associated with *Megalonyx leidyi*. The determination is by Cope.

EQUUS OCCIDENTALIS: Several teeth from Bluff creek, Clark county, agree perfectly with figures and descriptions of this species given by Cope.

EQUUS EXCELSUS: A complete upper dentition, agreeing quite with this species, was found in the Elephas deposit in Lane county, before mentioned, by Sternberg.

PLATYGONUS COMPRESSUS: The skeletons of peccary obtained from near Goodland in this state, I am more and more inclined to identify with this species, notwithstanding the differences they present. If the species is *compressus*, it is very important in the correlation of the Megalonyx and Equus beds.

CAMELOPS KANSANUS: This species described in 1856 from the "Drift" of Kansas by Leidy has never since been identified. Possibly it is the same as one or the other of the following species.

AUCHENIA HUERFANENSIS: This species was described by Cragin from Texas. Its identity with the Kansas species needs further identification, inasmuch as the bones from this state examined by Cragin are uncharacteristic.

CAMELID, species indet.: Two metapodials, differing considerably in size, are in the University collection, which can be referred to this family only at present. One of them, the smaller, was discovered by Mr. C. N. Gould in Barber county. The unworn fourth lower molar of a large species was dicovered by Mr. H. F. Rose, about 10 miles northeast of Dodge City.

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CANIS, species indet.: A complete mandible of a small species of dog was obtained in the elephant deposits in Lane county, by Mr. Martin. I do not, at present, have access to the specimen and cannot give the specific name.

CANIS LUPUS: A complete skull and other parts of the skeleton are in the University collection, obtained from near Goodland, in apparently the same deposits which yielded the *Platygonus* remains.

MEGALONYX LEIDYI: An excellent skull of this species, the type specimen, was obtained a few years ago from the Equus beds, near McPherson, associated with *Equus major*, a species found associated in the east with *Megalonyx*. Cragin has reported the same species from Clark county, associated with other species of Equus. *M. leidyi* was described by Lindahl.

MYLODON (?) species indet.: A fibula was doubtfully referred to *Mylodon* by myself in a paper in the Kansas University Quarterly. The bone came from 30 feet below the surface, at Seneca, Kan.

GEOMYS BURSARIUS: A number of skulls of this species were found associated with remains of the Alces described above, 50 feet below the surface in the "loess" near Kansas City. The skulls cannot be freed from the very hard matrix, but such portions as are exposed agree perfectly with the living species.

Bones of the living *Spermophilus tridecemlineatus* were found associated with the bones of Platygonus at Goodland, but I suspect that they were from old burrows.

Cragin has reported Felides from the Meade gravels, and Cope has described a saber-toothed cat (*Dinobastis*) from Oklahoma.

Usually the Pleistocene, or Quaternary deposits in eastern Kansas do not exceed 60 or 70 feet in thickness, though 150 is the thickness given for them at Kansas City by Mudge. At Lawrence, borings in the river valley gave about 60 feet as the thickness, or about 40 feet below the present river bed. Of course it is possible that borings elsewhere in the river valley might give greater depths. The material at these depths was coarse gravel, partly of glacial origin. Variations in the coarseness of the gravel and sand were found at different depths, but no fine, sandy marl was found save at or near the surface.

The Equus beds evidently form the whole of the superficial deposits of western Kansas. They are, toward the surface at any rate, composed of light-colored calcareous marl, the Plains marl of Hay, with sufficient clay to make fair bricks, which burn a light red. Its depth it is impossible to say, but I suspect that it is considerable. If Cragin is right in ascribing 200 feet and over as its thickness, then in all probability there are a hundred feet or more on the upland plains. In the river valleys, the material scarcely differs, save often for the greater proportion of calcareous material derived from the Cretaceous beds below them.

How these upland deposits were formed is not clear to me. That there could have been extensive lakes over these plains during Champlain times is impossible, since cotemporary deposits of local origin are found in the valleys, containing vertebrate fossils of the Champlain epoch, and lakes on the uplands must have been banked up to have existed. That they are river deposits is equally indefensible. Taking into consideration the uniform fineness of the material, the barrenness of the fossils, and their poor petrifaction, and the absence of coarser pebbles, everything seems to show an æolian origin.

Hatcher found evidence of unconformability between the Loup Fork and Equus beds in western Nebraska, and stated that Marsh had confounded them and confounded the fossils which he had described from them, which seems not

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at all unlikely in view of the bit of ancient history he has given us in the American Journal of Science for December, 1896, in his scheme of the nomenclature and characteristic fossils of the later Neozoic epochs.

Since the Loup Fork is Miocene or early Pliocene and the Equus beds are clearly late Pleistocene, it is quite certain that there must have been quite an interval between them, which in Texas is represented by the Blanco and Goodnight beds. The Goodnight beds exist in Kansas; and I confidently believe that the Blanco will be found also.

In conclusion, because of its pertinency to the present subject, I will quote from a paper of Cope's in the American Naturalist for 1895, p. 598:

"The Equus beds are found covering areas of various extent in Oregon, Nevada, California and the Staked Plains, southern Texas, Chihuahua, and the valley of Mexico. Their most eastern station is western Nebraska. They contain a fauna which includes one extinct species of the Megalonyx beds (Equus major DeK.) and the recent Castor fiber. They contain the extinct genus of sloths, Mylodon, of a species different from that of the east, and four species of camels of the genus Holomeniscus, and a peccary. Recent species of Canis and Thomomys occur, while two extinct horses (Equus occidentalis and E. tau) are common. The hairy elephant, E. primigenius, is abundant, while Mastodon americanus is rare, if occurring at all. The proportion of recent to extinct species and genera in the Equus beds is very similar to that occurring in the Megalonyx fauna, while they differ as to details. This fauna has also disappeared from the continent; a few species, as in the east, surviving to a later date. Was this disappearance due to submergence, as in the east?"

That there was any submergence of the western plains during the Champlain epoch, I cannot believe possible.

Cope's Megalonyx fauna of the east "includes the extinct genera of mammalia Platygonus, Smilodon, Megalonyx, Mylodon, Mastodon, and extinct species of Bos, Dicotyles, Equus, Tapirus, Ursus, Castor, Arvicola, and Lagomys."

As is seen above, all these extinct genera, with the exception of Smilodon, which is replaced by Dinobastis, occur in Kansas.

"The remains of man have been shown to occur in the gold-bearing gravels. I have found them (obsidian spear and arrow-heads) in profusion mixed with the bones of the extinct fauna at Fossil Lake, Oregon, in a friable and wind-blown formation. This man, however, so far at least as regards California, was not paleolithic, since he made mostly ground pestles and mortars."

"There is, therefore, considerable probability that man was contemporary with the Equus fauna, and the Equus fauna was contemporary with the Megalonyx fauna of the east," all of which conclusions the evidence from Kansas substantiates.

The problems of especial interest in the Neocene of Kansas are the position, thickness and characteristics of the Goodnight beds, the determination of the Blanco beds, and the relative extent of all these and of the Equus beds overlying them.

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THE BURIED MORAINE OF THE SHUNGANUNGA.

By B. B. SMYTH, Topeka. Read before the Academy January 1, 1897.

Ice flows. Like all fluid and plastic substances it flows along lines of least resistance. When heaped high and unconfined at the base it spreads at the base and becomes lower at the top. When climate is such as to cause a continued accumulation of snow at a certain place, the continued pressure of the overlying snow has a tendency to solidify the underlying portions and convert into ice.

Such were the conditions during what is known as the glacial period over all the region south of Hudson bay. A long-continued period of cold induced congelation of the vapors from the Gulf of Mexico into snow north of certain latitudes, depending on the season. With reduced temperatures all over the northern hemisphere, as stated in Volume XIV of these Transactions, pages 223 and 224, snow would fall during winter north of 38° north latitude, and all the year round north of 50°. West of 100° west longitude there should be little accumulation of snow; because, unless the humidity was much greater than at present, the annual precipitation west of that meridian should be less than the evaporation, and snow should generally disappear, whether melted or not.

Hence it happens, conditions of moisture and prevailing winds being considered as well as temperature, that the greatest snowfall, and consequently the greatest depth of ice, should be south of Hudson bay and north and northeast of Lake Superior.

HEIGHT OF THE ICE.

If the snowfall during each year should be 2½ feet, which when partially melted and packed into ice would be about four inches, and this accumulation were continued through 12,000 years (see volume cited, page 223,) the height of the ice would be about 4,000 feet, to say nothing of the added height of unpacked snow on top of that. The evidences of advance of the ice to the south are that the ice, at its culmination, was fully that high from the west end of Lake Superior to the east end of Lake Ontario, and that the great lakes were frozen up entirely solid, or nearly so. But it is probable that the height of the ice north of Lake Superior was somewhat greater, as the snowfall must have been greatly in excess of three feet per annum for a very long time.

From the south end of Lake Michigan the ice was pushed southward; from the west shore of Lake Michigan the ice was pushed to westward of south; and from the west end of Lake Superior the ice was pushed to the southwest until it met the great ice field that was being pushed southward in the valley of the Red river; thence it was deflected to the south.

Whatever the height of the ice was over Manitoba, or over Ontario north of Lake Superior, it was sufficient to push its foot clear down to Kansas, as shown by the drift and other glacial material in the northeast corner of the state, and by the line of boulders across the corner of the state on the outer margin of this drift area.

But suppose the ice in Ontario were not of sufficient height to push its foot into Kansas. It had a valuable ally in the great Missouri. Between Ontario and Kansas the Missouri flows over a vast tract of elevated plain situated for the most part, with its tributaries, west of the one hundredth meridian, and therefore in the arid region west of the glaciated area. The Missouri was shut out from reaching Hudson bay, and compelled to flow southward along the western margin of the ice field, making a new channel for itself. When the waters of the Mis-

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souri flowed down to the base of permanent ice, they became frozen and filled the valley — such as it was, ice on one side and land on the other — with ice, until the waters could flow to the eastward into the Des Moines river, in Iowa, and into the Grand river, in north Missouri, and westward until an elevation was reached commensurate with, though not equal to, the height of the ice.

The sands, muds and ground-up limestones that were carried down by the waters of the Missouri overspread the ice and found lodgment, on its subsequent melting, wherever it was carried to. Thus it is that we find what is called "loess," or Missouri river deposit, nearly everywhere in Marshall, Pottawatomie and northern Shawnee counties; in some places 60 to 75 miles from the present Missouri river.

This ice must have made the passage easier for the stones that were carried from the north; for we find boulders from Ontario arranged in a line along the outer margin of this loess-covered region, from Hollenberg and Hanover, Washington county, by way of Olsburg, St. George, and Wamego, Pottawatomie county, McFarland and Maple Hill, Wabaunsee county, Mission Center, Berryton, and Richland, Shawnee county, Belvoir, Clinton, and Sibley, Douglas county, to near Olathe, Johnson county.

Direction of Ice Flow.

The ice pushed southward across the Kaw river all the way from Wamego to Kansas City, and reached an extreme distance south of the Kaw of nine miles south of Topeka and 13 miles south of Kansas City. Thus the Kaw was blocked for a short time, but not to cause it to overflow across the divide into the Osage, except possibly for a very short time.

Wherever in Kansas any evidences are to be seen regarding the direction of ice flow, the ice seemed to radiate by curved lines, from nearly straight south in the Missouri valley to west of south in the Delaware valley, 30 miles to the west, and to south of west in the Blue valley, 75 miles to the west.

At Kansas City a few scratches seen on the limestone rocks and reported some time ago indicate a direction of ice flow a few degrees east of south. Scratches, however, are very scarce; they have all, if any ever existed, been worn away long ago.

At Lawrence, all indications seem to be that the ice flowed nearly straight south. Mount Oread, upon which the university stands, is a ridge standing directly north and south. It has had its sides sharply planed by the ice, which must have flowed nearly parallel. If there were any difference of pressure upon its sides, its east wall would seem to have been smoothed the best; though pressure there was not strong enough to carry any of the stones over the crest of the ridge. Indeed, there is no evidence on the south end of the ridge, where the university stands, that the ice passed over the hill at that point; though farther north, where the ridge is lower, there are boulder clay and small quartzite pebbles at one or more points, showing that the ice passed there. The high northern end, overlooking the Kaw, has not been examined.

At Topeka the direction of ice flow seems to have been south 17 degrees west. There are no scratches on the rocks. The only evidences are the general trend of the three parallel ridges upon which the city is built and the general trend of the moraine in front, which is exactly perpendicular to those ridges.

Further west the principal evidence of ice flow is the general trend of the moraine, which is generally perpendicular to it.

Course of the Moraine.

The line of the moraine, as it crosses Shawnee county, is thus: Commencing at the east line of the county about three miles north of the southeast corner of

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TERMINAL MORAINE AND GLACIAL LAKES IN S

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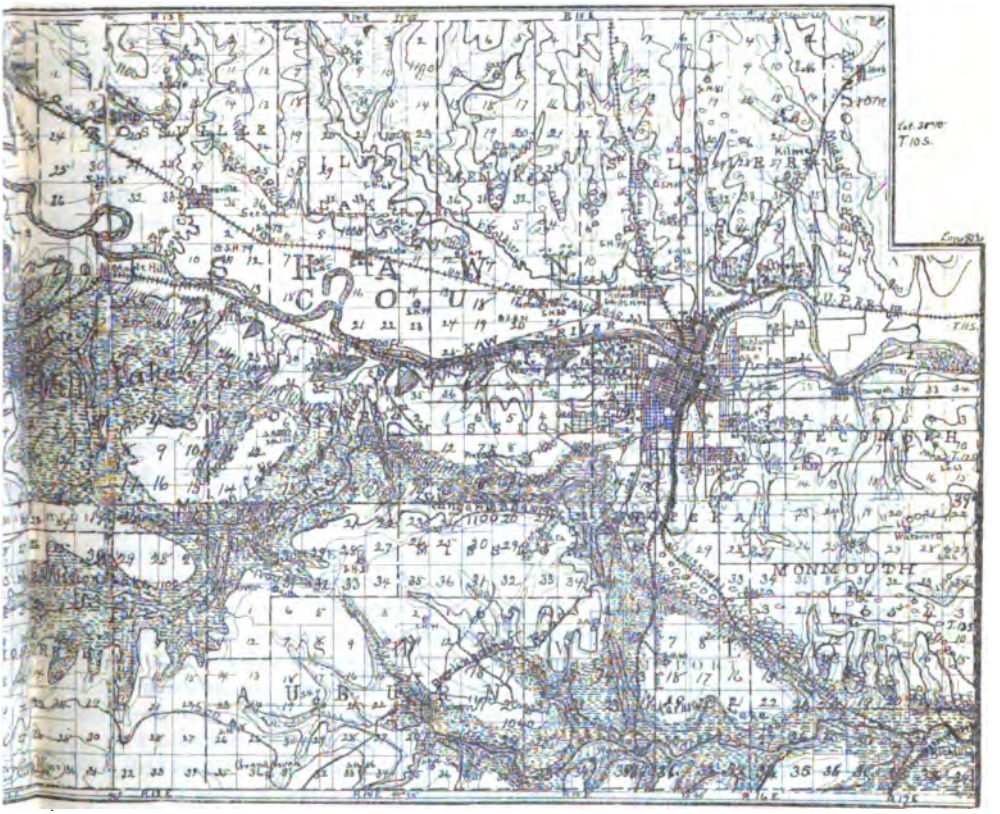

IN SHAWNEE AND WABAUNSEE COUNTIES, KANSAS.

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the county, it traverses the county westward and crosses the west line of the county about 10 miles north of the southwest corner. Its length in the county is about 30 miles, though the county is but 24 miles across.

For 10 or 12 years, since teaching at Richland, I have been interested in tracing out this line in the eastern part of the county, and have walked repeatedly over every foot of it from the east county line to Burnett's mound. The boulders are found continuously on the south edge of the bluffs north of the Wakarusa from the east line of the county to the mouth of Lynn creek. The boulder belt follows up Lynn creek to Tevis and Berryton, and continues in the same general course past Pauline and school district No. 11 to the southwest quarter of section 23 (township 12 south, range 15 east), half a mile from the ridge running south from Burnett's mound. Here it turns sharply to the north and runs along the crest of a ridge on the west side of sections 23 and 14, across the M. I. Lee place and to the Hoffman farm, on section 11, just south of the Shunganunga, two miles north of the turning point. Here it disappears.

A recent attempt, after much previous searching, to find the lost moraine, in company with Dr. Wm. Smith, sr., resulted in finding it in an unexpected place, namely: covered up in the bottom of the Shunganunga creek, and extending for two miles up the valley of the creek. It reappears on the Hammond place, at the southwest corner of section 16, south of the creek and in a line with that part of moraine east of the mound. From this point it continues across the county in a line north of west, agreeing with that portion in the eastern part of the county.

The Buried Moraine.

The first evidence of it in the creek bottom is by the creamery south of Seabrook, and just northwest of the Hoffman place. Here there are a number of large boulders, the largest nearly spherical, and about five feet in diameter. They are well water-worn, as are all boulders lying in the bottom of the creek.

I had no difficulty in tracing the moraine up the valley of the creek, although there was no evidence of it at the surface; for, walking southwestwardly in a straight line in the direction I believed the moraine ought to lie, every time I came to a bend in the creek I saw boulders in abundance in the creek bottom, even to a depth of three feet at the middle of the moraine. At such places the boulders were visible in the banks up to a height of 10 feet or more. Wherever the creek crosses the moraine at right angles the breadth across it, measuring along the bed of the creek, is from 25 to 40 paces. Going down stream, and approaching the moraine, the bottom of the creek slopes upward, until the middle of the moraine is reached, then it slopes rapidly downward. The difference in level of the mid-morainic and non-morainic portions of the creek bottom is about three feet; that is, the non-morainic portions of the creek bottom would need to have three feet or more of water before it would commence flowing over the boulders farther down.

The banks of the creek are generally about 25 feet high. The lower 10 or 15 feet is composed of drift material and boulders; the upper portion is native earth, washed in from the surrounding hills, effectually obscuring the boulders except where exposed by subsequent wash.

At one of the southerly bends or loops, say the third from the creamery, the creek reaches the moraine from the northwest, turns and runs along the top of the moraine for about eight rods, then turns and runs off to the north again. This stretch is paved with boulders. Near the middle of the bend several blocks of limestone lie on top of the boulders in such a way as to indicate that they had fallen from some overhanging cliff on the south side of the creek. An inspection of these blocks, which contain a few fusulina and a very few other fossils,

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showed that they had belonged in the limestone stratum just above the coal; though that was nowhere in sight. The south bank of the creek at this point appears entirely of drift material. Boulders occur in the bank to a height of 15 feet. One boulder about 16 inches in diameter was held bound between the roots of an elm tree nearly three feet in diameter, near the top of the bank. The height of that boulder above the bottom of the creek is a trifle over 15 feet. The tree is firmly rooted in the bank, and has not yet begun to topple over, although several of its large roots are exposed.

At another similar bend up the stream — call it the fifth — the creek cuts entirely through the moraine, and runs parallel with the moraine and partly on top of it for a distance of about 10 rods. Along this course the creek has cut forward into the original undisturbed strata south of the creek for an apparent depth into the bank of four to eight feet or more. The coal stratum, where not covered with talus, is here plain to be seen about 15 feet above the creek bottom. It is overlaid with a stratum of shale about 18 inches thick, and this is covered with a solid stratum of limestone 2½ feet thick. This accounts for the blocks of limestone in the other bend below. The creek, in coming from the northwest, strikes the original bank at an acute angle, so that the drift portion of the bank thins out until it disappears, and the bank of native strata succeeds eastwardly. The bank here is vertical, slightly overhanging at a height of about 18 feet. The line of junction between the native and the drift portions of the bank is vertical, and can be distinctly seen from a height of 8 feet up to 20 feet. Here the drift boulders are jammed into the vertical face of the original bank, some of them so firmly that they still cling to the face of the native bank, though the supports have been removed by the creek. The front edge of the limestone stratum at this point is slightly lifted and the boulders and drift material jammed and wedged firmly in under it for about one or two feet. This illustrates the tremendous pressure that was exerted upon the drift material as it was being pushed from the north. The lower eight feet of the line of junction was not seen, being obscured by talus, and the time taken for examination did not admit of any digging. A few rods further up the creek, where the drift bank is exposed to the base, the drift material reaches down to the bed of the creek, and how much deeper is not known.

At the sixth bend, the creek, after crossing the moraine to the south, does not run along the moraine, but has cut a new channel to a distance of about 15 rods into the original stratified earth, then turns and recrosses the moraine to the north. This portion of the creek was not examined. The length of the paved portion of the creek here is 45 paces. It is slightly diagonal across the moraine.

At the upper end of the next bend the coal is just above the paved bed of the creek, and here it is worked. Here a straight cut-off comes from the bend further up. It passes on the north side of the moraine, and is parallel with it. This cut is about 150 feet long and 25 feet wide. It has vertical banks 20 feet high, apparently fresh, and its floor is naked limestone, about three feet higher than the bed of the creek. On the south side of the cut, boulders appear in the bank to a height of 10 feet; on the north side drift clay, small boulders, and pebbles, partly stratified, from the clean rock floor up to a height of eight feet, then mixed with prairie earth, gradually changing to clear prairie earth above.

There are no glacial scratches on this floor. Possibly, if there ever were any, the overrunning water and pebbles have worn them away; though the water does not run in the cut unless it is at least three feet deep in the creek above; otherwise, it runs around in the old channel. No effort was made to discover any scratches on that portion of the limestone floor that is covered with drift;

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though it is not all probable that any existed there. The current on the lime stone floor must have been too strong. Then, too, the glacial deposit must have been partly dumped there and partly washed down the current of the stream, in addition to being pushed from the north.

The buried moraine was followed no further in the bed of the creek. The spot last mentioned is on section 16, northwest of the mound. Half a mile further up, about Burnett's old cabin, there are very many boulders, some of them of good size, both in the bed of the creek and on the north bank.

Upper Shunganunga.

Still another half mile up, the moraine emerges from the creek on the Hammond place, near the south line of section 16. Here it forms an east-and-west ridge south of the creek about 15 feet in height above the prairie, and apparently 10 feet or more in depth of drift material. The total distance to this point from where the moraine disappears in the bottom of the creek is a little over two miles, and its course is south 65° west. On the Major Sims place, on section 17, the moraine is on both sides of the creek, thus being double at this point. On the north side his house is built on the morainic ridge. The well, 18 feet deep, is entirely in drift. Water is abundant and unfailing. From the Hammond place the moraine continues its regular course of north 67° west across the county.

Two miles west of Mission Center the moraine is entirely on the north side of the creek. The broad valley of the creek is gone. It here consists of a gorge about 50 feet deep and not 20 rods wide. A little further west the depth of the gorge increases and the water flows west toward Blacksmith creek. The bank north of the gorge is covered with drift and boulders; the south bank is capped with fusulina limestone three feet thick.

Advance Moraine.

Nearly half a mile south of this, resting high and dry on the sloping prairie, there is an outlying border belt, a sort of advance moraine, as it were, of fusulina limestone boulders. They are composed almost solidly of fusulina shells and no other fossils; so their horizon is unmistakable. Here, they are stretched east and west across the prairie fully 20 feet above their locus, and more than a quarter of a mile south of the bank from which they were lifted. If they were also carried down stream, as well as pushed across to the south, then they were lifted more than 20 feet; because the strata dip toward the west.

This would seem to indicate that the local ice of the valley had been pushed up out of it, carrying the top of the ledge of rock with it. Subsequent thawings, refreezings, and pushings, in advance of the glacier, and at its foot, succeeded in working these rocks to their present position. It would also indicate that the influence of the glacier was felt long before its foot reached the Shunganunga.

Reflections.

From these observations I would draw the following conclusions:

1. This Shunganunga creek existed during glacial times very much the same as it is now.

2. When the ice-field reached the creek in its southward progress, it crossed the lower portion of the stream as far up as section 11, half a mile northeast of the mound.

3. From that point, near the creamery, up to and beyond Burnett's cabin, a distance of two miles, the ice never crossed the Shunganunga, except for a very short time.

4. The ice never touched Burnett's mound, though it stood around it on three sides to a height equal to or greater than the top of the mound.

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5. A strong torrent washed the base of the ice on the west, north, and east sides of the mound, laying bare the bed-rock, and even cutting through it north of the mound.

6. The water escaped east of the mound by overflowing at Pauline into the Wakarusa.

7. The ice on the north side of the mound dumped its load into the bottom of the denuded Shunganunga valley.

8. This deposit was not merely dropped, but was pressed heavily against the foot-wall on the south side of the valley.

9. This deposit was afterward covered up by wash from the surrounding hills, and so rendered invisible except where subsequently exposed by the creek.

Glacial Lakes.

An ancient shore-line is distinctly to be seen surrounding the mound at an elevation of about 50 feet below its summit. About 30 feet below this a second shore line is seen. This lower one is nearly 200 feet in breadth on the north side of the mound. This follows along the hillside to the west as far as the eye can see. It passes around the mound to the east side, and follows the side of the ridge to the south as far as one can see from the mound.

In the Wakarusa valley a glacial lake was formed, reaching from three miles below Richland, where the ice-field crossed the Wakarusa, back to Auburn, a distance of 20 miles, and having an average breadth of three to four miles.

Allowing levels to be the same then as now, the depth of the Wakarusa lake, near Belvoir, its deepest place, was 250 feet; at Richland, 200 feet; at Wakarusa station, 150 feet; and at Auburn, about 50 feet.

The depth of the Shunganunga river, at its deepest place, north of the mound, was 125 feet, and in the shallowest part of the gorge, connecting its head with Blacksmith creek, was 75 feet.

A glacial lake formed on Mission creek, extending from the Moon road-crossing back southwestward into Wabaunsee county 15 miles. Its breadth was about two miles. It overflowed across Blacksmith creek into the Shunganunga river.

A glacial lake formed on Mill creek, reaching from Maple Hill westward away beyond Alma, and southward about seven miles. Its deepest place was at Maple Hill, exceeding 200 feet. It overflowed southward into Mission lake. The top of Buffalo mound, like the top of Burnett's mound, stuck up out of water.

The greatest lake of all was formed on the Kaw, from Wabaunsee up past Manhattan, westward on the Smoky hill to Salina, and northward on the Blue nearly to Blue Rapids. All the waters of this Kansas lake overflowed through the valley between Wabaunsee and McFarland into Mission lake and later through the Shunganunga river around Burnett's mound. The depth of this Kansas lake at Manhattan was a little over 150 feet.

On retreat of the glacier the Wakarusa ran out first, followed by the Shunganunga; this in turn was followed by the Mission lake; next the Mill creek lake was free to run into the Kaw. Finally the glacier retreated from the Kansas river between Wamego and St. Mary's, and the Kaw was open over its whole course. Had the glacier lingered longer until 75 feet more of earth were removed in the valley between McFarland and Wabaunsee, the course of the Kaw would have been changed into the valley at present occupied by Mill creek.

Small icebergs floating in these waters account for an occasional boulder and a little drift material south of the moraine.

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New Visit.

In 1895 a new visit was made to the buried moraine in company with Prof. F. W. Cragin, of Colorado Springs, and Dr. Wm. Smith. One object of the visit was a confirmation of the assertion that the boulders were pressed into the south wall of the valley, as described in the "fifth bend." By some mischance that particular bend was overlooked, showing that a miscount was made either on one or both trips; and while the oversight was suspected, it was not positively known until the "cut-off" was reached; and it was then decided not to retrace. The point was neither reaffirmed nor refuted.

Another point we desired to know was whether the southwest sides of the boulders were more highly polished than the other sides, as observed in the moraine near Blacksmith creek (a point mentioned in an article read before the Academy of Science in December, 1894.)*

Lee Moraine.

The particular portion of the moraine examined was the two-mile north-and-south strip east of Burnett's mound. The statement was not confirmed here. The most highly polished side was not oriented in any direction. Directions were various and about equal. This may be because the moraine trends north-and-south, and the boulders are thus protected from the prevailing winds.

Observations were limited to the half mile on the Rowles place, along the west line of section 23 and just south of the old M. I. Lee place. The ridge here appears to be composed entirely of drift, and there are many large boulders. Half a dozen metamorphic sandstone boulders were found that were incrusted more or less up to one-eighth of an inch in thickness with a brown ferruginous sand. On removing this incrustation with a sharp implement and some force, the face of the stone was seen to be polished the same, or about as much, as where the stone is exposed. If stones had been imbedded in a bank of iron sand during one or more interglacial epochs previous to the Kansan epoch, then they were polished before they were deposited in the bank of iron sand, and not by dust attrition since they arrived here. Is this reading the lesson correctly? Then again, it is as reasonable to expect, if they had been deposited together before, they would be taken up at the same time in the advance of the ice during the Kansan epoch and deposited together here, as that they would be scattered many miles apart along our moraine. However, similarly incrusted stones are to be found elsewhere.

This two-mile strip of moraine is nearly level along its crest and does not vary in elevation perhaps more than 25 or 30 feet at different points. The highest point is near the north end, about half a mile south of the Shunganunga which comes close to the north end. The moraine is from 200 to 300 paces across, and from 30 to 50 feet higher along the middle or crest than along the sides, where it changes to prairie earth containing some drift but no boulders.

On the Rowles place, on section 23, half a mile south of M. I. Lee's house, the ridge is bisected by a preglacial gap, through which runs a branch of Colby creek, flowing northward into the Shunganunga. Its depth is about 85 to 90 feet; its breadth 12 to 15 rods at the bottom. It cuts the ridge squarely across. The little stream, after passing through the gap, turns to the north. The floor of the gap is glacial drift. A new well for stock is dug close to the north bluff. The well is about six feet deep. A limestone ledge, two feet thick is at the top of the well, at the base of the bluff. The material in the side of the well under the limestone ledge is drift. All the earth thrown from the well is drift clay and

*See Trans. Kan. Acad. Sci., XIV, p. 225.

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small boulders. The bottom and banks of the little creek are of prairie earth, with a few small boulders. It is probably underlaid by drift. About 10 rods east of the well, in the north bank of the gap, there is a small vertical washout at the base of the bluff, up to a height of 40 feet. The depth of the washout into the bank is about eight feet. Its sides hold grass and shrubs. At the bottom, which is fresh, the native strata in the hill are exposed. The deposit at its foot forms a truncated semicone about five feet high and 60 to 80 feet across. It is mostly glacial material. The entire end of the hill, as well as the sides of the ridge, is covered with glacial drift.

About 50 feet above the base of the bluff, and about 40 feet below its summit, the edge of a stratum of limestone crops out at the south end of the ridge. Very little of it is to be seen through the enveloping drift. Some pieces of the limestone are lifted slightly from their position, upturned, and pushed around toward the west. They are held in that position by the packing of drift material about them.

In passing down the sides of the hill in any direction it is difficult to determine, without digging, where the solid covering of drift ends and the superficial covering, or talus, begins; as drift covers the entire upper surface of the hill down to 50 feet or more. But, using our best judgment, Professor Cragin and I estimated a thickness of 30 to 35 feet of drift on top of the ridge. If it be supposed to be all drift above the limestone, it would be about 40 feet. Elevations were made with an eye-level and an aneroid barometer.

This moraine contains boulders of local rock in addition to the quartzites and metamorphic sandstones. Especially noticeable were some blocks of purple-brown ferruginous sandstone filled with large irregular nodules of snuff-colored or brownish-yellow ochery clay. This is before spoken of as argillaceous ironstone. I have seen this in the Dakota sandstone in central Kansas, but do not know where it outcrops north of here; probably not within the state.

Broken stones were frequently noticed in the moraine. Some of the sandstones and conglomerates were separated along planes of stratification, through the ordinary process of weathering; but some sandstones and quartzites were split across through the solidest part, as though done through concussion or shock. One quartzite boulder, 10 feet in diameter, half a mile east of Burnett's mound, is broken into three pieces. The pieces lie close together with the fractured faces facing each other. The interior faces are rough and covered with lichens. Other large fractured boulders are known elsewhere.

How Boulders Break.

How to account for the breaking of these stones is a problem. I hesitatingly offer this solution:

A stone fell from the ice and struck another. If the perpendicular height of the ice front were, as before stated,* equal to or greater than the height of Burnett's mound, it would be, say 100 to 200 feet. That fall would of itself be insufficient to break a stone, when 75 feet of that distance was through water and floating ice. Observations made on glaciers by other observers have shown that, though dirt and small pebbles sink into the ice during sunshine, the rays of the sun do not penetrate large stones, but they act as a protection to the ice underneath. Stones carried in the middle of a large ice-field will, in the course of time, reach the surface by the melting of the superjacent ice as the ice is pushed to

*See Trans. Kan. Acad. Sci., XIV, p. 222.

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the south. At the surface the surrounding ice becomes melted until the boulder stands on top of a taller-growing pedestal of ice. *

An ice-field covering most of Iowa, northern Missouri, northeastern Kansas, and eastern Nebraska would be thinnest at its edges, whatever that thickness might be. It would be thickest along its middle line, and increase in height to the north until the snow-field was reached. The rate of ascent on a level plain has been estimated by various observers at 25 to 75 feet to the mile. The ascent should be most rapid from the south, by reason of the more rapid melting and the greater pitch of the earth's surface in that direction.

A field of ice that is spread over a plain should have the smoothest surface of any form of glacier. Rain or melted ice would simply run off, seeking the shortest cut to the ground. No need to account for interglacial streams or vast crevasses. While most likely the margin was deeply cut everywhere by water running down, the upper portions of the field must have been comparatively smooth and solid. It should resemble the remarkable Fan glacier of Redcliff, pictured and described by Professor Chamberlin in Journal of Geology, Vol. III, No. 4, p. 470, only on a vastly grander scale and sloping downward much less rapidly. But the slope should be continuous, and constantly increasing as the edge of the field was approached.

When our field reached its greatest southern extent and began to retreat, the weather of July must have been hotter and moister than at present because of contiguity of the earth to the sun and of the Gulf of Mexico to the ice. A hot south wind blowing for three days as at present should remain above the freezing point for several hundred miles over the field of ice. Is it too much to say the surface of the ice would melt for 500 miles north of Kansas City? The ice would be melted by rainfall as well as by sunshine. A southwest wind would bring as much heat and much less moisture. In either case the surface would melt except where protected by the large boulders, whose pedestals were still growing taller.

If we allow that the slope of surface toward the south was 25 feet to the mile, the ice 100 miles to the north of here should be 2,500 feet in thickness and greater still further north.

A Grand Coast.

A hot day comes. Many warm days have preceded it. A boulder weighing 100 tons stands on a high pedestal 100 miles north of Topeka. The south wind blows. The boulder is undermined on the south side. The column breaks and the boulder is forcefully flung to the floor of ice. The ice is nearly level, but it descends gently to the south. The boulder has momentum enough in its fall to start it sliding to the south. The ice is smooth and solid. What is there to stop the boulder? Does it strike the icy pedestal of another boulder? Let it glance off, and with a graceful curve resume its course. The descent increases slightly. The momentum increases. The velocity increases greatly. Soon the force and speed becomes tremendous. It rivals a railroad train. It surpasses the pneumatic dispatch. One hundred miles an hour. Give it an hour, it ought to reach its destination.

The ice over which it slides is growing dirty and hummocky. The friction is insufficient to stop the boulder. The dirt polishes the stone. The hummocks fly before it. A train of smaller stones follow behind it. Who shall estimate the heat developed in the boulder during its rapid transit?

* See 13th Ann. Rep. U. S. G. S., Part II, p. 70, second expedition to Mt. St. Elias, by Israel C. Russell; surface features of the Malaspina glacier.

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In front yawns a precipice. It is filled with icy water. A small granite boulder of hardest texture rests on a solid limestone ledge in front of the ice-field. Water to a depth of 75 feet flows over the ledge.

The big moving boulder comes shooting over the brink of the ice. The little resting boulder is its objective point. The resting boulder is not immovable. The moving boulder is not irresistible. The little boulder does not sink crushed out of sight into the limestone. The big boulder does not get broken into a thousand pieces and scattered over the surrounding country. The water breaks the force of the big boulder's fall. The little boulder breaks the big boulder's back.

Or is it broken by the sudden cooling by immersion in the icy water?

Does sliding any distance over the ice at the rate of 100 miles an hour polish a stone as much as sliding the same distance over the ground under the ice at the rate of 100 miles in a thousand years? Why not better?

My story is told. I have attempted in my feeble way to account for the high polish some of these stones have; to account for how boulders within a hundred miles or more of the edge of the ice-field may become suddenly transported to the terminal moraine on retreat of the ice; and to explain how some of the boulders may have become broken.

I here present a map of the counties of Shawnee and Wabaunsee, showing the course of the moraine across them, and the probable location of several glacial lakes.

THE McPHERSON EQUUS BEDS.

By J. W. Beede, Topeka, Kan. Read before the Academy January 1, 1897.

There is a formation of considerable economic and scientific interest located in McPherson, western Marion, Harvey, and northeastern Reno counties. A large channel is carved out of the Permian shales, and, in the northern part, Dakota sandstone. Its eastern limit is a line trending north and south along the west side of Sand creek to a place a few miles north and west of Lehigh, Marion county. Here it turns westward about 20 miles, then northward to the Smoky Hill river. Its western boundary, beginning at the Smoky Hill river, runs just east of Edwards creek to the Little Arkansas river, south of which the sand-hills seem to encroach upon its area. It is well shown in the wells at Halstead, and in all probability extends to the Arkansas river. The "Tertiary Grit," referred to by Professor Hay,* just west of Wichita, is probably an outcrop of this formation, as, on the margins of the area and the isolated patches, the sand is imbedded in a limy matrix which makes it resemble the Tertiary grit farther west.

Over the deeper portions of the channel and well to the western edge lies a chain of lakes and basins extending from the large basin two miles west of McPherson to the Arkansas river, south of Patterson. The area north of the Little Arkansas river is about 800 square miles. South of it, it is probably 100 square miles, exclusive of the sand-hills.

Topography.

The rough surface of the Permian to the east, the Dakota to the north, and the peculiar topography of the sand-hills to the southwest, form a marked contrast to the monotonously level surface of the Equus beds area. There are several

* Bull. 57, U. S. Geol. Surv., p. 34, fig. 9.

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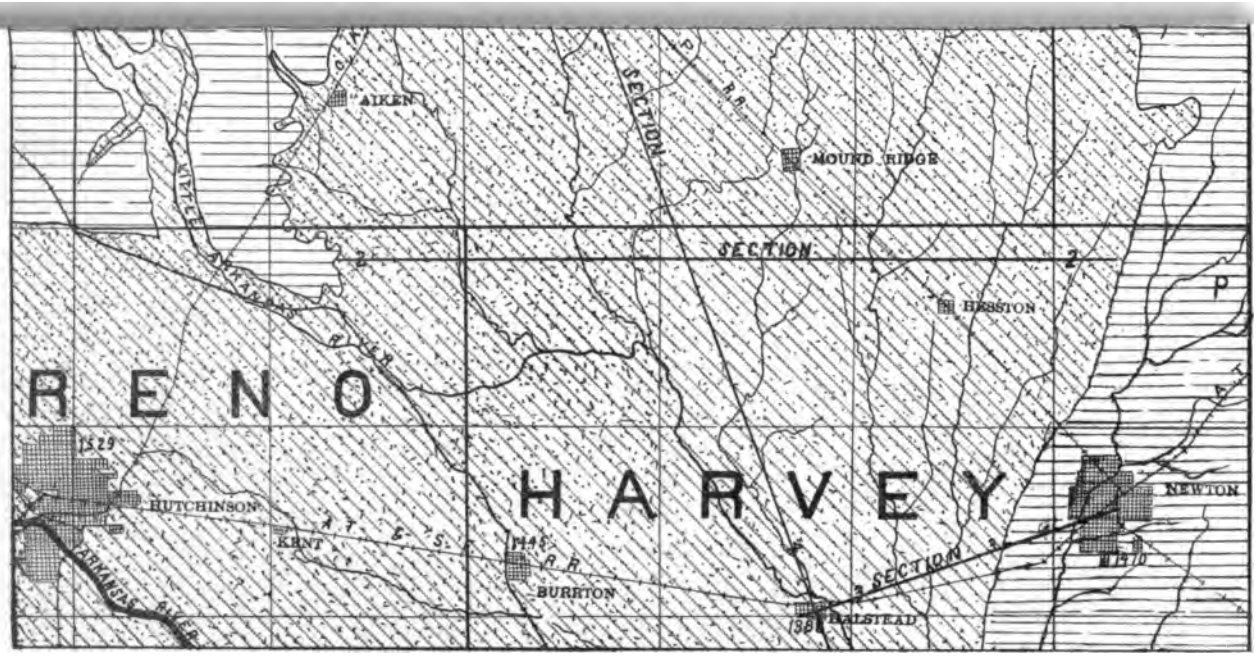

GEOLOGIC MAP OF McPHERSON AND SALINE COUNTIES, KANSAS.

Diagonally ruled and lightly stippled, .	Equus Beds.
Heavily stippled, ...	Dakota.
Solid black, ...	Comanche.
Horizontally ruled, ...	Permian.

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places where one may travel three or four miles without varying very perceptibly from a dead level. Along the east and west section line two miles north of McPherson one may go 10 miles without passing a sag of more than 20 feet. As a rule there is just enough slope to the surface for good drainage, while occasionally the water stands in lakes and basins in slight swales in the surface. The largest basin is nearly three miles in diameter, and is situated two miles west of McPherson. The largest lake is Lake Inman, 10 miles southwest of McPherson.

The divide between the Arkansas and Smoky Hill rivers passes through this area and averages a little more than 1,500 feet A. T.* The Arkansas river at the southeastern limit is 1,290 feet, A. T., a fall of 200 feet in 60 miles. The Smoky Hill river, at the nearest approach, is within four miles of the divide, but its bed is nearly 200 feet below it. The Little Arkansas river drains the entire area of the Equus beds, except a very small portion north of the divide drained by the Smoky Hill, whose tributaries are rapidly cutting into the divide, and will cause it to migrate farther to the south in the course of time, as the streams at the south are already at their base levels and are not carrying away the soil to any considerable extent.

Structure.

These beds consist of alternating layers of clay and sand, with a stratum of "volcanic ash" in a part of the northern area. Near the bottom of the deepest part of the channel is a heavy stratum of gravel, which passes through McPherson, Harvey county, and Halstead, respectively. This bed lies at a depth of 140 to 150 or more feet at McPherson and contains an abundance of water, as it does wherever it is found. The upper part of the gravel stratum grades into a stratum many feet in thickness, which is partly argillaceous and partly arenaceous, sometimes containing isolated sand-beds, or at least sand-beds of great irregularity, and which contain very little water. The upper surface of this stratum is nearly on a level with the rim of the deeper channel. Over this, and also extending over a slightly undulating Permian floor for 15 miles to the east, is a stratum of sand varying in thickness from 30 feet (at McPherson, according to Prof. S. Z. Sharp) to three feet in places farther east, but averaging six or eight feet in thickness. This stratum also contains a good supply of water. It covers the entire area of the Equus beds except, perhaps, a portion to the north. The uppermost stratum is composed of clay, varying in color and texture. It covers the entire area, and is from 10 to 35 feet in thickness. Within this clay layer in the northern part of McPherson county is a stratum of "volcanic ash" 18 to 24 inches thick. Nodules of calcium carbonate are frequently found in both the upper and lower strata of clay. They are irregular, but generally show a slight roundness of form. Some of these are quite hard, while others are quite soft, as is the case at the McPherson sand-pit, on the Boggs farm two miles southeast of the city, where it is 20 inches thick in places. A specimen of this was submitted to Dr. G. P. Grimsley, who states that it is "one mass of small prismatic crystals with pyramidal terminations, with strong double refraction and no cleavage. They effervesce with acids and are crystals of aragonite ($CaCO_3$), the orthorhombic form of calcium carbonate." No structure could be determined in the hard nodules. Doctor Grimsley pronounces the "volcanic ash" as "glass grains or flakes, fine and angular, some of which are feebly doubly refracting." A specimen of the sand was examined by him and found to be "rounded quartz grains with a number of angular ones." Specimens of the Dakota sandstone and sand from the Dakota sand-hills were also pronounced of the same character, except differing in

* U. S. topographic sheets.

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fineness. As no feldspar grains were found in the sand, it would seem to have originated from the Dakota sandstone rather than to belong to the Tertiary sands to the west or to the glacial sands farther east.

The fossils of this formation are those of the Equus beds according to Dr. S. W. Williston. Those reported are:* *Megalonyx*, subsequently described as *M. leidyi* Lind., *Equus major* DeKay, *Spherium striatum*, Lam., *S. sulcatum* Lam., *Pisidium abditum* Haldeman, *Anodonta* sp., *Valvata tricarinata* Say, and *Gammaria* sp.

It may be well to note here the physical characteristics of the rocks through which the valley containing the Equus beds and the present valley of the Smoky Hill are cut. The former is in the main cut through soft, easily eroded Permian shales. The northern part has been cut through a considerable amount of Dakota sandstone. The 200 feet and more removed from the north of this is largely Dakota (60 feet of Permian). The section at the Smoky Hill buttes will give a good idea of the general nature of the rock — a few feet of soft sandstone at the bottom, then 110 feet of shale, and 200 feet of sandstone (soft and friable), now a covered slope, constitutes the section. The latter is probably sand, as the water percolates through it freely down to the top of the shales, where it breaks forth as springs. The upper part of the 200 feet is a comparatively hard sandstone 10 or 12 feet in thickness. Though the texture of the above may vary, and does, for different localities, the hardness and friability remain practically constant, making the material admirably suited for rapid erosion. This is true of the entire eastern portions of McPherson and Saline counties.

Origin.†

Two papers have been published on this formation, one by Professor Udden,* the other by Professor Sharp.‡ The latter expresses the opinion that it is of glacial origin. It was thought that the ice formed a dam across the Kansas river somewhere below, and that the water backing up to Salina burst through the divide at the place where the north end of this formation is situated. In evidence of this theory he cites some boulders on Battle hill as being of glacial origin, dropped or deposited by a stranded iceberg from the terminus of the ice sheet.

The boulders on Battle hill, Battle Hill township, McPherson county, are not the rounded quartzite boulders of the moraine, but cross-bedded sandstone of the Dakota formation lying nearly in place. They are about three feet thick, hard and angular, some of them quite large. There is also an absence of other moraine material which a melting iceberg or ice sheet would certainly have deposited. Rocks very similar to these may be seen in place a mile southeast of Salina, two miles north of Twin hills (northeast corner of Delmore township, McPherson county), and four miles west of Battle hill. Here the soft, almost incoherent, sandstone removed from beneath the hard sandstone has allowed the large blocks of the latter to gradually tip and tilt over the surface of the hill, and some of them have worked their way down its sides some distance. In one of these, on the northeast face of the hill, the lower part grades into the brownish Dakota sandstone.

The elevation of Battle hill is about 1,550 feet, which is about the same elevation as the highest deposits of the Equus beds. The elevation of the terminus

* Udden, American Geologist, Vol. VII, No. 6, June, 1891.

† Some of this discussion was furnished by Prof. E. Haworth, as the work was done in connection with the University Geological Survey.

‡ Bulletin Kansas State Board of Agriculture, quarter ending March 13, 1894, part 2, pp. 26-30.

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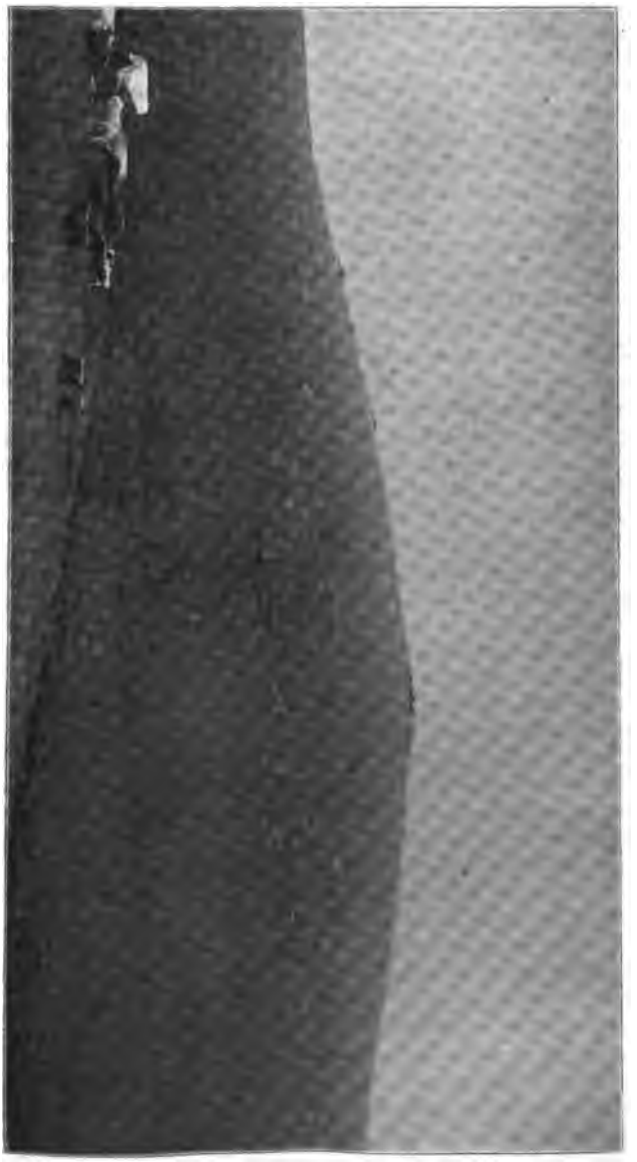
PLATE VI.



(From University Geological Survey, Vol. II.)

SOUTH TWIN HILL, McPHERSON COUNTY, KANSAS.

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of the ice sheet in Shawnee and Wabaunsee counties, so far as definitely located, is about 1,050 feet, or not over 1,100 feet A. T.* The planation of the surface is so slight that, were it not for the small amount of material left by the glacier, it would have been difficult indeed to have recognized the former existence of glaciers in that portion of the state. Consequently it seems probable that the ice sheet was comparatively thin at its southwestern extremity, the limit of which is not yet entirely known. The elevation of the divide between the Kansas and Marais des Cygnes rivers south of Topeka is 1,100 feet. This is over 400 feet below the boulders of Battle hill, or the more elevated deposits of the Equus beds. How far up the Kansas river the loess is found is not known, but it probably does not extend to the flint hills in Wabaunsee county. It seems probable, therefore, that the waters of the Kansas river would have flowed around the foot of the glacier to the east of these hills rather than rise to an elevation of 1,550 feet, which is even higher than the divide between the Kansas and Neosho rivers in the flint hills of Wabaunsee county, which are now considered to be quite above and to the south of the terminus of the ice sheet.

Professor Udden, in the article above referred to, suggests that the water which deposited these beds must have connected with another body of water in the valley of the Smoky Hill river to the north, and states that the river has cut its channel through these deposits.

The elevation of the McPherson divide at its central point is a trifle over 1,500 feet. To the southward, at a distance of 38 miles, the Arkansas river flows at an elevation of a little over 1,400 feet, or a fall of 100 feet in 38 miles. The bed of the Smoky Hill river, eight miles farther north, is 1,300 feet. The city well at McPherson, starting 1,475 feet A. T., was put down 150 feet (the present water-supply is taken from a depth of 140 feet) without striking the bottom of the deposit. This makes the bottom of the well about 25 feet above the bed of the Smoky Hill river two miles south of Lindsborg, or about the same level as the bed four miles east of Marquette, still on the northern boundary of the Equus beds. The present elevation of the Arkansas river at the mouth of the Little Arkansas is 1,290 feet. The great range of elevation of the Arkansas in passing the beds is due to the distance it travels in passing them, while they are narrow at the northern end, and the Smoky Hill flows squarely across the deposit. The relation of the two river beds and the records of the McPherson and Halstead wells is shown in section 4, plate III. The section begins at the mouth of Sharps creek and passes along the western edge of McPherson and a trifle east of Halstead to the Arkansas. .It will be seen at a glance that the two rivers are at the same level at the extremities of the section and that the gravel in the McPherson well lies exactly in the same level, while the gravel in the Halstead well is below it. The fact should also be borne in mind that the Arkansas has reached its base level and filled its channel to some extent, though how much is not definitely known.

The above figures would seem to indicate that at one time the Smoky Hill river ran south instead of north and emptied into the Arkansas. But it is difficult to understand why it should have excavated so great a channel and covered so great a flood plain here and so narrow a valley west of Marquette. However, the encroachment of the sand-hills on its southern area may offer a slight suggestion as to the partial choking of the southern outlet causing more rapid deposition to the north and thus elevating the channel and widening the flood plain.

But there are other facts which seem to detract from this explanation of these

* All elevations based upon U. S. topographic sheets.

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deposits. If the Smoky Hill at one time flowed south into the Arkansas, then one of a number of conditions must have obtained.

First. The Saline could have received a short tributary from the southwest, occupying the position the Smoky now has throughout that part of its course above Salina where it flows north. The source of this tributary could have gradually migrated southwestward by natural processes until it captured the Smoky at the point of the big curve in the present river. The accumulation of sand above referred to along the northern side of the Arkansas would have assisted this by elevating the mouth of the old Smoky. But unfortunately for this view no portion of its course south of McPherson is as high as the high McPherson ridge, which is 1,500 feet A. T. near McPherson to the north. Were this formed by the natural filling-up process in the old valley of the Smoky before its capture, we should find some evidence of a corresponding filling further up stream in the present valley, and a widening of the valley corresponding somewhat to the present valley occupied by the Equus beds. No such filling or widening is noticeable. Further, at all points above the McPherson ridge, the bottom of the channel must have been at least as high as the ridge, and a short distance away it must have been higher. At present, one must pass up stream, at least 30 miles, to above Ellsworth, before the river channel has an elevation of 1,500 feet. After the capture, on account of the Saline being so much lower than the Smoky in its hypothetical position, a rapid deepening of the channel would have occurred through a distance of from 30 to 50 miles above Salina, and a new flood plain, the present one, would have been formed. No such phenomena have been observed. The present wide valley above Salina also somewhat opposes this view, as it is difficult to understand how the short tributary supposed to have captured the Smoky could have produced so wide a valley, while its width and depth at present between Lindsborg and Salina seem altogether too great to have been excavated since the deposition of the Equus beds. The Smoky Hill buttes, Soldier Cap mound, Iron mound, and North Pole mound register the ancient elevation of the surface of Saline county, and indicate the removal of over 200 feet of material, consisting of Dakota sandstone and shales and Permian shales, from the entire valley, which is nine miles wide in its widest place, including Dry Creek valley. The valley between the Smoky Hill river and Dry creek is now largely covered with Pleistocene river deposits, with occasional mounds of Permian shale rising to the surface. The average width of this valley is about 2½ miles, over which the sand and clay average about 35 to 40 feet in thickness. The bed of Dry creek is about on a level with the bed of the Smoky Hill river, and during very high water in the latter it overflows its banks at Bridgeport, and part of the water runs down Dry creek and empties into the Saline north of Salina.

Second. It may be supposed that at one time the Saline and the Smoky flowed south into the Arkansas, joining each other at the big curve in the Smoky south of Salina. In this case a short tributary of the Solomon, occupying the present position of the Smoky between Salina and Solomon City, would have been the capturing stream, tapping the Saline near Salina, and ultimately causing the Smoky to flow up the old Saline channel from the point of confluence of the two streams to the point of capture. The whole valley of the Saline, therefore, must have been elevated above the McPherson ridge, and probably would have had a flood plain of considerable width, while the flood plain of the upper Smoky would have been about the same as above given in the first supposition. When the capture was made, the great fall from this supposed elevation at Salina to Solomon City would have caused a rapid deepening of the channel in both

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the Saline and the Smoky, and new flood plains would finally have been formed along both streams, as already explained for the Smoky. No such conditions have been noticed along either stream. Further, the great elevation required for the Saline would have carried it across the uplands into the Solomon above Minneapolis. Neither does the character of the present valley between the mouth of the Saline and the mouth of the Solomon river appear to have been so recently a mere lateral to the Solomon.

Third. If the materials of the Equus beds were brought down from the west by the Smoky Hill river, or by any other stream, or if the materials were largely of glacial origin, then they should correspond closely in character with the recent river sands or with the glacial material. Almost every handful of sand gathered from the Arkansas, the Smoky, or Saline, streams passing through the Tertiary of the west, is largely composed of feldspar gravels, and frequently fragments of other rock-forming minerals are seen. Likewise the sands of the lower Kansas river valley, which are so largely of glacial origin, have a great abundance of feldspar gravels. But the sands of these Equus beds, so far as examined by Doctor Grimsley, seem to have no feldspar whatever. This strongly implies that they were obtained directly from the Dakota sandstone, as that rock is almost, if not entirely, free from feldspar gravel, in this part of the state.

At present it must be admitted that no satisfactory explanation of the Equus beds channel, nor the agency for the deposition of the materials, has been advanced. A further study of the problems involved is in progress.

Economic Interest.

This strip of country is particularly fertile and very valuable farm land. The soil seems to possess nearly all the peculiarities necessary to the growth of the various farm products. It is so level that it can almost all be cultivated, the uplands being about as good as the bottom lands. The water-supply is almost ideal. Over the entire eastern portion, at a depth of 18 to 30 feet, pure, soft water is found in good supply. The soft, arenaceous texture of the clay above the sand beds containing the water makes well-digging easy. Over the western portion the wells vary from 40 to 150 feet deep, but the water is always good, and there is an "inexhaustible" supply of it. The amount of water contained in this lower gravel bed of small extent is remarkable. A glance at section 4 will suggest that the supply may be traced, upon further investigation, to the Smoky Hill and Arkansas rivers.

The streams have no timber on them worthy of note; but on the uplands and in the valleys cottonwoods and other trees thrive wherever planted, their roots penetrating the clay to the sand for water. This is in marked contrast to the country to the east, where the Permian shales are the country rock, and the cottonwoods grow to be fair-sized trees and then die.

The rainfall is sufficient on this area to produce a fair crop almost every year. The area covers over 900 square miles, and may be said to be the richest farm land of any area of its size in the state, and its inhabitants the most thrifty.

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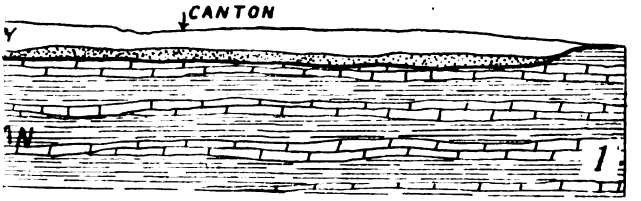

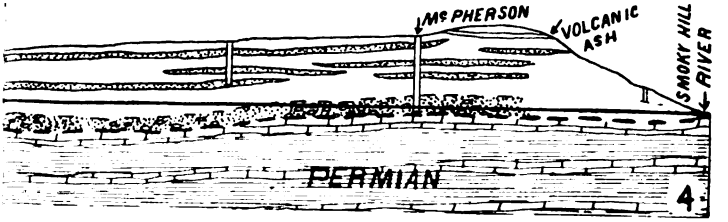

Y HILL RIVER TO HALSTEAD.

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THE MENTOR BEDS.

By A. W. Jones, Salina, Kan. Read before the Academy January 1, 1897.

The First Biennial Report of the Kansas State Board of Agriculture contains an article on the geology of Kansas, by that distinguished pioneer geologist, Prof. B. F. Mudge.

In this article Professor Mudge stated that the fossils of the Dakota consisted of a few remains of fish and saurians, dicotyledonous plants, and a few marine mollusks,* which he stated in a following paragraph were found in only three localities: two in western Saline county, near Bavaria, and one in Clay county. This was to me the first mention of this very interesting and apparently limited formation, that has since been written up under the name "Mentor Beds" by Prof. F. W. Cragin, of Colorado College, and published in the *American Geologist*. Later in the same article Professor Mudge accounts for the peculiar distribution of the fossil vegetation in the Dakota by stating that the forests were probably on small islands surrounded by shallow seas; and, taking this for granted, I naturally concluded that at the same time that the fossil leaves were formed in the sand and mud of the island shores the fossil mollusks were formed in the surrounding seas. But some eight years ago I made a collecting trip in the vicinity of Brookville, and by mere chance stopping at a farmhouse for water where a well had been recently dug on a hillside, I was much interested in finding a quantity of the shell-bearing stone lying about that had been thrown out in digging the well. Upon inquiring, I was told that a layer of it about four feet in thickness had been penetrated at a depth of about 40 feet; and on the same hill a short distance above the well I found leaf-bearing Dakota sandstone.

This and subsequent observations on several outcrops of the shell-bearing stone caused me to think that it might be a distinct formation underlying the Dakota. During the summer of 1895, Prof. F. W. Cragin, of Colorado, called upon me, and I drove out with him to examine some outcrops of this formation. Professor Cragin had previously visited other localities in the county, and had become convinced that it was a formation distinct from and underlying the Dakota. In the course of conversation the subject of a suitable name was discussed and the name of Mentor was fixed upon, the little village of Mentor being near the center of the best exposures, although the village is situated in the broad valley of the Smoky Hill river, and no well-defined outcrops of it occur within three miles of the station. The Mentor is found in more or less abundance over the greater part of Saline county. It is to my certain knowledge clearly defined in 12 of the 20 townships, and I think a careful investigation will reveal its occurrence in nearly every one. It is also found over a large area in northern McPherson county, and to some extent in Ellsworth, Lincoln, Ottawa and Clay counties, and probably exists in Marion and Dickinson counties.

The fossiliferous strata of the Mentor consist of ferruginous and arenaceous sandstones, yellow, red, brown, or black in color, usually soft and friable, generally well filled with internal and external casts of shells with the shell material usually entirely obliterated, although in some instances traces of pearl remain.

In several instances, however, I have noted outcrops that had the appearance of the typical "Mentor" stone, which required some diligent searching to reveal any fossils.

* The mention of fish and saurian fossils in the Dakota by Professor Mudge was based upon the reports of others, and was erroneous. No such fossils have been found in the Dakota.

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Associated with the sandstones are white, yellow, buff, or bluish-colored shales and clays, the geological position of which is still a matter of uncertainty to me. I have been at a loss to know just how much of these belong to the Mentor.

So far as I have been able to determine, the thickness of the strata varies from a few inches to 70 or 80 feet, and in a few instances the Dakota appears to rest directly upon the Permian, with no trace of Mentor or Kiowa.

It appears to lie altogether between the altitude lines of 1,200 and 1,400 feet, and rests in part conformably upon the Kiowa, and in part unconformably upon the Permian. According to Professor Cragin, the following species of mollusks are found in the Mentor:

Ostrea franklini Coq.
Anomia sp.
Gervillia mudgeana White.
Barbatia parallela Mk.
Nucula catherina Crag.
Trigonia clavigera Crag.
Lucina ? sp.
Protocardium texanum Conr.
Corbicula subtrigonalis Mk.
Tellina subscitula Mk.
Leptosolen conradi Mk.
Margarita mudgeana Mk.
Sphenodiscus pedernalis VonB.
O. quadruplicata Shum.
Avicula salinaensis White.
Modiola pedernalis Roem.
Trigonarca salinaensis Mk.
Yoldia microdonta Mk.
Crastellina oblonga Mk.
Cardium kansasense Mk.
Corbicula nucalis Mk.
Cyprimeria texana Roem.
Arcopogella mactroides Mk.
Mactra siouxensis M. & H.
Turritella seriatim-granulata R.

Of these I have verified the most, and have a few that I have not certainly determined that may complete the list.

A comparison of the species found in the Kiowa shales with the Mentor reveals several species common to both, which seems to indicate a close relationship. In Walnut and Greeley townships, Saline county, the Mentor is found resting conformably upon what I take to be the Kiowa of Professor Cragin, and an interesting gradation is noticeable. The grayish calcareous shale of the Kiowa gradually changes to a dark reddish brown as it approaches the contact with the Mentor and appears to merge into it. A specimen of fossiliferous Mentor was obtained less than three feet above the Kiowa.

On the other hand, the stone bearing the fossils strongly resembles the Dakota, in some instances appearing nearly identical with some of the leaf-bearing sandstone. In one instance I found imperfect leaf impressions and fossil wood less than 50 feet above the Mentor on the same hill, and the sandstone intervening showed scarcely any change in general appearance.

Briefly summed up, then, it seems that in the character of its sandstone and some of the associated shales the Mentor strikingly resembles the Dakota. But with respect to its fossils it resembles the Kiowa and Denison groups of the Comanche. In conclusion, I will say that I do not wish to advance any theories. I have done some theorizing for my own gratification, but feel that my limited experience in geological work would not warrant me in making these public, at least until I have studied the matter more thoroughly. I will, however, venture a question: Is it not possible that the difference in conditions, of temperature, depth of water, character of sea bottom and adjacent shores may have been sufficient to account for the variation in species from the Kiowa, even though they were cotemporaneous?

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GEOLOGY OF EFFINGHAM RIDGE—PRELIMINARY REPORT.

By J. W. WILSON, Effingham, Kan. Read before the Academy January 1, 1897.

The ridge under discussion lies in northeast Kansas, with a general north and south trend. The portion under present discussion runs through the center of Atchison county. The crest passes one-half mile west of Effingham, the seat of the Atchison county high school. The elevation of the railroad track, just west of the Delfelder bridge crossing the Central Branch of the Missouri Pacific railroad, one-half mile west of the city limits, is 22.5 feet above the front step of the county high school, as recorded by our aneroid barometer. The difference in elevation between the county high school and low-water mark at Atchison is 327 feet. This makes a total of 394 feet difference between the elevation of the ridge and low-water mark at the Atchison bridge. The elevation drops 182 feet from Delfelder bridge to Muscotah, near the western boundary of the county. This ridge, as has been stated, extends nearly north and south, varying northeast, and is the watershed dividing the waters that flow west into the Delaware river from those flowing east into the Missouri.

Near the east base the Oread limestone outcrops and is about 20 feet thick. This ledge can be traced almost entirely across the state. It is the ledge upon which the State University stands. At the western base of the Effingham ridge, in the bluffs along the Delaware river, are found a number of outcrops of limestone, from which nearly all the building rock of the western part of the county is obtained. In the bed of the Delaware river sandstone beds are occasionally found. Along the west base of the ridge are also found extensive deposits of coal—in some places over a foot in thickness—and from which, 20 years ago, all the coal supply of the county was furnished. The city of Effingham at one time secured all her coal from this region. These veins are worked in but few places now, owing to the cheapening of coal by improved machinery. The shales associated with this coal are very rich in vegetable and animal fossil remains.

The principal limestone ridge in the vicinity of Muscotah is three-fourths of a mile west of town, on a farm owned by William Dunkel, and will in the future be known as "Dunkel Ledge."

This outcrop is about 50 feet above the town, and is frequently seen near the tops of the mounds east of the Delaware, between Muscotah and Arrington. The use of a transit has been secured by the county high school, and these ledges will be carefully worked out in our survey to be carried on next summer.

The general dip of the rocks of this region is to the northwest. Muscotah is a little south of west of Atchison. Supposing the average dip in this direction is five feet to the mile, the Dunkel ledge, being about 264 feet above low-water mark at Atchison, is therefore 162 feet above the Oread limestone. These readings have not been verified by repeated experiments with the barometer, but are approximately correct. They make it probable that the coal of this region is in about the same horizon as the Osage county coal.

I am inclined to believe that the limestone ledges west of Atchison will, when carefully worked out, be correlated with the Dunkel ledge, and probably constitute the bed rock supporting the water-bearing sand in the interior.

GLACIAL DRIFT.

I have frequently found in the western part of this county and in Nemaha county fragments of red sandstone resembling the Dakota Cretaceous. I think I have seen evidences of a moraine south of Atchison. Numerous boulders have

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been found over the county. One east of Arrington measures 7½x6 feet, and formerly protruded three feet above the ground. The Agassiz Science Club is keeping a record of the location and dimensions of these boulders, on a map prepared for that purpose. One of the most interesting studies in this section is the glacial drift, which constitutes most of the surface of Atchison county. I have found it varying from a few feet in thickness to over 100 feet. During the past two years arrangements have been made with well borers to collect, in boxes prepared for the purpose, specimens of clay passed through, together with the thickness of the clay beds. This work has not progressed far enough to reach any definite conclusions. The clay lies in sharply separated beds, some of which are very thick. In 1868, Prof. Louis Agassiz, accompanied by Roscoe Conkling and others, visited northeast Kansas. Agassiz recognized in the red, gray, and green boulders on our hills a verification of the glacial theory he had worked out in his native Switzerland, viz., that these boulders were brought here by the ice sheet which about 10,000 years ago covered all the northern part of the northern continents. The ice sheet grated over the surface of the country, scraping up huge boulders and smaller particles from the limestones, granites, and greenstones of Canada and from the red quartzites of Minnesota and Dakota. These boulders were dropped by the melting ice on the prairies.

I have carefully observed this glacial deposit covering northeast Kansas from Kansas City to Junction City and Washington county. I have seen it at West Point and other places up and down the Hudson river; in Central Park, New York city; in the Sierra Nevada mountains, and along the Pacific coast. In fact, the ice sheet sprinkled its boulders and mud on top of the older deposits over all the northern continents as far south as the 39th parallel of latitude.

NOTES ON KANSAS PHYSIOGRAPHY.

By J. W. Beede. Read before the Academy January 2, 1897.

General Outline.

Kansas erosion is from plain to plain rather than from ridge to plain. In other words, the elements have an elevated plain to break up and reduce to a plain of lower elevation, instead of a high ridge to reduce to a base level, as is the case in mountainous regions. At present, the parts under consideration are intermediate forms, varying according to the nature of the rocks of which they are composed and the climatic conditions to which they have been subjected.

In various parts of the state good examples of these intermediate forms of reduction may be seen, modified by climate and structure. The youngest is in the Red Beds, in the more highly developed part, and illustrates an early stage of reduction. The original plain is represented roughly by the more elevated summits, while the valleys and cañons represent the amount of material removed. A more advanced stage of erosion is represented in the eastern extremity of the Dakota formation. Here a slightly different climatic condition has obtained, and there is also a difference of rock structure. It has been subjected to other conditions which are as yet but very little understood. Near the Smoky Hill valley, the Permian shales on which the Dakota rests sink to a lower level than to the eastward or westward, which seems to be due to erosion, producing a marked unconformity. It may indicate a pre-Dakotan drainage channel. Section 3 is in the Carboniferous of eastern Kansas. This is the oldest of the

four regions, and has been subjected to the most active erosive agencies, yet its systems of chert-bearing limestone have withstood the degrading influences to a wonderful extent. The Permian shales are practically homogeneous, so far as our purposes here are concerned. In this locality erosion has nearly completed its more active work.

The Red Beds.

A section extending from Medicine Lodge in a southwesterly direction across the Salt Fork, Barber county, passes through a highly developed portion of the Red Beds. The elevated summits represent approximately the primal plain.

The climate here is quite arid, and the streams are dry during the greater part of the year. Vegetation is sparse, especially at the heads of the arroyos. Farther down the streams vegetation becomes more abundant, and trees are quite common. On the hillsides the grass is so thin that the red earth may be seen for miles, even in the summer months. The lack of vegetation at the very heads of the streams, where it would retard degradation the most, makes the conditions most favorable for rapid erosion, and has probably played no unimportant part in determining the present topography of the region. Plate IV in the foreground shows the grass only in little bunches far apart, as is the general rule. In the upper part of this formation is a stratum of gypsum 25 feet in thickness. Under this are several hundred feet of soft arenaceous and argillaceous shales and sandstones which seem to be much more easy to erode than the gypsum. The gypsum tends to preserve the original plain, while the rapidly-eroding shales form large, steep escarpments and the "Mansard Buttes" of Professor Hay.* These are illustrated in plate V. The minor streams have not yet reached their base levels and are dry most of the year, corrading their beds only in times of flood, and producing the cañon-like topography peculiar to these conditions. The greater streams have about reached their base levels and are beginning to widen their valleys. As a consequence, there is very little bottom land or high prairie, the country being simply a system of hills and sharp valleys.

Notwithstanding the fact that there are many conditions favorable to erosion, yet through the lack of perennial streams and springs and the uneven distribution of the rainfall in this locality, which comes within a short time in the spring, degradation seems to progress less rapidly than in some other parts of the state. The Medicine Lodge river has cut a fairly wide valley through this formation, and is not corrading its channel to a very great extent at present, but is wearing away its bluffs. Its bed is covered with "quicksand," over which flows a small stream of water.

The Salt Fork flows, largely, in a small cañon in its course through Comanche and Barber counties. Its bed is covered with sand from the Tertiary formation at its head. The smaller streams flow in V-shaped valleys which are often quite deep, and at the heads of which are occasionally semicircular excavations with vertical walls sometimes 40 feet high. These places are sometimes several rods in diameter. On the ridges the ground is nearly level, and these depressions cannot be seen until approached within a few rods. Good examples of this form of an arroyo head may be seen a few miles southwest of Medicine Lodge and on the small tributaries to the north of the Salt Fork, in Comanche county. At the place where the Medicine Lodge river passes through the eastern limit of the gypsum, the gypsum weathers in little outliers between the main bluff and the river, forming round hills capped with gypsum. The side next the river is some-

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*Bull. No. 57, U. S. Geol. Surv.

times 200 feet high and very steep. A series of these may be seen on the south side of the Medicine between Sun City and Lake City, Barber county.

The Dakota Sandstone.

The nature of the eastern extension of the Dakota formation is well represented in Saline county. It illustrates the outlier system of outcrop, which, instead of a connected front, is a system of islands separated from the general mass, sometimes several miles. The material of which this formation is composed is soft shales, and friable, with occasionally harder, sandstones. These rest upon the argillaceous shales of the Permian. The surface of the latter is quite uneven, and is considerably depressed in the vicinity of the valley of the Smoky Hill river, as is represented near Lindsborg. This depression seems to continue north and south, conforming more or less roughly to the valley of the Smoky Hill river in Saline county. The McPherson Equus beds are deposited in a similar but larger depression to the southward, which may be in part a prolongation of this old channel or depression. Just what this old channel has had to do with the present drainage system of this region is hard to tell at present, though it seems to have had some influence upon it.* It may indicate a pre-Dakotan drainage system in this portion of the state.

It seems not impossible that this old drainage system may have connected with the Red Beds sea to the southward. If this is the case it would make the majority of the Red Beds of post-Permian age.† The topography of the region is peculiar to itself. The Smoky Hill buttes stand 400 feet above the Smoky Hill river and 300 feet above the surrounding country. This elevation is composed of Dakota sandstone and shales, and is practically isolated from the main outcrop. Still east of this there are two more islands of less height but far greater areas, which are separated several miles from the main outcrop. The majority of the large streams flow at right angles to main outcrop, while the lesser ones are monoclinal. The lesser streams cut rapidly back into the easily eroded material, and in time cut entirely through the divides, separating the strata into islands disconnected from the main formation. But in making the great valley of the Smoky there seems to have been more than the normal forces at work.* At Mentor the valley is nine miles wide. The great susceptibility of the formation to erosion has caused the work of degradation to progress more rapidly and further than in the Red Beds. Vegetation is more abundant than in the Red Beds, but its influence has not been sufficiently great in comparison to retard reduction to any very marked degree. The streams run at their base levels, or nearly so, and their valleys are fairly wide, in which vegetation is quite luxuriant. The rainfall in this region and the Red Beds have been about the same,‡ the chief difference being in its distribution.

The last trace of the original plain is probably indicated by the Smoky Hill buttes, Iron, Soldier Cap, and North Pole mounds. The eastern portion of this formation is perhaps less developed than the western and shows a great diversity in structure and color, and is highly cross-bedded, and ripple markings are common.

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* See article on "McPherson Equus Beds," *ante*.

† Since this was written Dr. S. W. Williston gives an account of the discovery of some Permian vertebrate (*Cricotus collettii* Cope) from Kansas which seems to correlate the lower Permian of Kansas with the Red Beds of Texas. Doctor Williston says: "Above the stratum in which these bones are found are several hundred feet of limestones and shales, above which come the Red Beds of Clark and Comanche counties, which have been variously referred to the Permian and Trias. That this basal Permian fauna continued throughout 800 or 1,000 feet of deposits does not seem probable to me, and I believe yet more strongly, what I always have believed, that the Red Beds of Kansas are Triassic in age. . . ." Kan. Univ. Quar., Vol. VI, No. 1, Jan., 1897, Series A, p. 56.

‡ See Report Board of Irrigation Surv. and Exp., Kan., for 1895 and 1896, p. 195.

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PLATE VII.

(From University Geological Survey, Vol. II.)

DAKOTA SANDSTONE AT TOP OF SOLDIER CAP MOUND, SALINE COUNTY.

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The Carboniferous Shales and Limestones.

Plate IX * is from Abilene to Kansas City, along the Kansas river. It crosses the limestone systems exposed in that part of the state, and represents a different topography from the two previous ones. The drainage systems are very old. The larger streams are anaclinal and the smaller ones are monoclinal. Vegetation is abundant on upland and lowland. The streams are perennial and have reached their base levels. Even the small ones are filling their beds with mud. Valley widening has progressed to a considerable extent. Though this section has been exposed to the elements for a longer time than either of the others, yet it presents a surface nearly as rough. Its shales erode easily, it is true; yet the massive chert-bearing limestones resist the agencies of degradation to a wonderful degree. They dip to the west about 10 or 15 feet to the mile. Thus we have a system of high limestone-capped steps as we ascend the Kansas river. The extreme difficulty with which the arroyos corrade their channels in the heavy limestone prevents their being cut into outliers to any considerable extent. As a consequence, the line of outcrop has a very irregular lateral lobing.

The drainage systems here seem to have much the same outline as prior to the Kansas ice invasion, as their present valleys are almost coincident with those prior to the glacial epoch.† They would seem to be older than those of the western portion of the state, as the latter must be younger than the pliocene deposits through which they flow, and the erosion of such extensive valleys in preglacial times, and in such quantities of limestone as these formations in the eastern part of the state contain, must have consumed a considerable time, even under fairly extraordinary conditions. The hills of this region are projecting ridges which vary from 50 to 150 feet in height. The higher are beautifully terraced, especially those on the southern tributaries of Mill creek, in Wabaunsee county, where the upper part of the Wabaunsee, Cottonwood and part of the Neosho formations are present in the same ascent.

The climate is more moist in this than the preceding regions. The heads of the arroyos are more densely covered with vegetation. The agencies of degradation have been more active, and at work longer than in either of the other regions; yet the effect on the surface outline is not very much greater. This difference must be attributed to the combined effect of vegetation and the presence of the limestones, the latter of which is by far the greater, as the discussion of the next locality will demonstrate.

The eastern portion of the section (IX) has been subjected to the abrading influence of the Kansas ice invasion. It will be noticed that there is a slight reduction in the surface when the glaciated region is entered near Willard; yet it is little more than would be expected from the natural results of ordinary erosion.‡ Indeed, if it were not for the materials left by the glacier, it would be hard to discover that there had ever been a glacier south of the Kansas river west of Lawrence.

The Permian Shales.

This region is in Sumner county, and the section extends from north of Arkansas City through Geuda Springs west to a place about eight miles northwest of South Haven. Here the surface rock is composed largely of Permian shales which erode quite easily. The long-continued action of erosion has nearly completed its more active work. These shales may be taken as nearly homoge-

* From Univ. Geol. Surv. Kan., Vol. I.

† The valley of the Kansas river is lined in places on both sides with drift and loess, as are the valleys of some of the smaller streams.

‡ The limestone in this section is exaggerated in order to be represented.

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PLATE VIII.

(From University Geological Survey, Vol. II.)

DAKOTA SANDSTONE BLUFFS, SIX MILES WEST OF BROOKVILLE.

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neous so far as our purposes here are concerned. The streams scarcely flow in their beds, and the country is monotonously level. The locality receives about five inches more rain per year than either of the first two, and five inches less than the third, farther to the northeast.* It has not been exposed to the weather longer than the third, and has received less rainfall. The abundance of vegetation is similar in the last two regions, save the fact that trees are almost wanting in Sumner county. Consequently we must attribute the great difference in topography to the presence of limestone in the one and the absence of it in the other.

Thus there is a varied topography, which difference of structure, together with slight difference of climatic conditions, has produced in a comparatively level plain.

NOTICE OF SOME VERTEBRATE REMAINS FROM THE KANSAS PERMIAN.

By S. W. WILLISTON, Lawrence, Kan. Read before the Academy January 2, 1897.

Some months ago numerous fragments of bones, obtained from an excavation of a well in Cowley county, were sent me for examination by Mr. C. N. Gould. The horizon whence the bones came was clearly lower Permian, not far from its base, as accepted by Professor Prosser, the recognized authority on the Kansas Permian stratigraphy.

Not knowing whether additional material will be obtainable, I give here a description of some of these bones, which will be more fully illustrated in the future should no better specimens be secured.

An intercentrum clearly belongs to the genus *Cricotus*, and is closely allied to the typical species described by Cope from the Permian of Illinois.† His description applies so well to the specimen in hand that I use his language, amended:

"The caudal intercentrum best preserved is short, discoidal in form, and deeper than wide. The articular faces are deeply concave, the posterior more strongly so, and the middle is occupied by a foramen, whose diameter is about equal to one-half that of the intercentrum on either side. The lateral borders of the posterior articular face are less rounded than the anterior ones. The chevrons are slender and directed very obliquely backward, and their bases are firmly coössified with the intercentrum. On the superior surface two shallow pits occupy considerable space. They are separated by an obtuse ridge, and are bordered by a raised ridge from the polished layer of the lateral surface. Several phalanges of short, wide proportions show much resemblance to those of certain dinosaurs."

Diameter of intercentrum, vertical.....	18			mm.
Diameter of intercentrum, transverse..	17			"
Diameter of intercentrum, longitudinal,	11			"
Proximal width of phalanges..	12	12	13	mm.
Proximal depth of phalanges..	8	7	6	"
Length of phalanges.....	14	15	11	"

Another vertebra of smaller size doubtless represents a true centrum (see Cope, Trans. Amer. Phil. Soc., XVI, p. 245). It differs very materially in having remote sutural surfaces for the attachment of the neural arches, in being some-

* Rep. Board Irr. Surv. and Exp. Kan. for 1895-'96, p. 195.
† Proc. Acad. Nat. Sci. Phila., 1875, p. 405.

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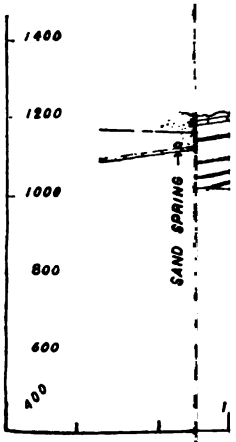

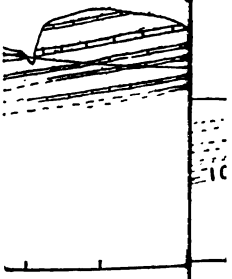

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what cordate in shape, and in showing no surfaces for articulation of the chevrons. The ends are concave as in the intercentrum, and the notochordal foramen is of the same relative size. The anterior lips of the cup are more beveled than the posterior ones. The outer surface is concave longitudinally, with an obtuse keel below. The posterior sutural surface for the arch is much larger than the anterior. There are no longitudinal ridges on the sides of the centrum, as shown in the figures of *C. crassidiscus* Cope (labeled *C. heteroclitus* by Zittel). The floor of the neural canal is flat.

Transverse diameter of centrum.....	15 mm.
Vertical diameter of centrum	13 "
Length of centrum.....	7 "
Width of neural surface..... ...	5 "

Numerous portions of sculptured scutes and plates and a fragment of a jaw with one complete tooth I doubt not belong with the vertebræ.

None of the characters are sufficient to distinguish the species from the other described ones, especially *C. heteroclitus* Cope.

A single dorsal vertebra, and perhaps some phalanges, belong clearly to the genus *Clepsydrops* Cope, also originally described from Illinois, and are closely allied to the typical species. In its description I follow Cope's language in the paper first cited for a dorsal centrum: "It is deeply biconcave, the articular cavities being funnel-shaped and continuous, thus perforating the entire length of the centrum. . . . The cavities communicate by a very small orifice. In an anterior dorsal the anterior cavity is as widely excavated at the border as the posterior funnel. Another peculiarity is the absence of the processes of the centrum, and a small capitular articulation is seen sessile on the border of the cup of two of the dorsals. The dorsal vertebræ have their sides somewhat contracted. In one specimen the inferior face is longitudinally acute. In this dorsal the floor of the neural canal is interrupted by a deep fissure, which has a triangular shape, with the apex downward when seen in profile. The diapophysis does not project far beyond the base of the neural arch." It is sessile, with an elongated, cupped articular surface.

The phalanges are of more slender form than those of *Cricotus*. The shaft is depressed and the distal condyle is not emarginate.

Length of centrum	15	14	mm.
Depth behind		12	"
Width behind.....	14	12	"
Length of phalange.....		13	"
Depth, proximally.....		5	"
Width, proximally.....		8	"

As will be seen, the centrum, while nearly the same size as that measured by Cope of *C. collettii* (second column), are of somewhat different proportions, but not sufficiently so to justify specific separation.

Associated with these remains are numerous teeth and spines of *Pleuracanthus* (*Didymodus ?*) and plates of a ganoid fish.

All together, we have here an interesting series of forms, so closely resembling the species described by Cope from Danville, Ill., that I cannot distinguish them specifically. It would seem to demonstrate the contemporaneity of the two formations, and also that of the Texas Permian, whence the species of all these genera have been described by Cope.

Above the stratum in which these bones are found are several hundred feet of limestones and shales, above which come the red beds of Clark and Comanche

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counties, which have been variously referred to the Permian and Trias. That this basal Permian fauna continued throughout all the time represented by 800 or 1,000 feet of deposits does not seem probable to me, and I believe yet more strongly what I always have believed, that the red beds in Kansas are Triassic in age. If they be Triassic, and corresponding to the red outcrops in the foothills in Colorado, it would seem strange that the intervening deposits between them and the Dakota, in the regions separated by only a few hundred miles, and agreeing in many lithological characters, should be in one case Cretaceous and in the other Jurassic.

GYPSUM IN KANSAS.

By G. P. Grimsley, Topeka, Kan. Read (by title) before the Academy January 2, 1897.

Historical Introduction.

Gypsum (sulphate of lime), from two Greek words, *ge* (earth) and *epso* (to concoct), is a mineral that has attracted attention from very early times. The transparent variety, known as selenite, was used by the ancients as a substitute for glass in windows. The best varieties were supposed to be in upper Egypt and in Syria. It was also in favor for ornamental boxes, and for urns, in which lighted lamps were placed, and so threw a soft light through the apartments. The walls of the temple Fortuna Seia were made of compact gypsum, and the interior, though without windows, is described as "sufficiently lighted by rays transmitted through the semi-pellucid walls." The writings of Theophrastus show that the Greeks were familiar with the use of plaster of Paris, made from calcining the gypsine stone in making casts. The term "alabaster" is commonly noted in the ancient writings, and sometimes refers to compact gypsum and sometimes to the stalactite carbonate of lime, so that it is often difficult to tell from the meager descriptions which is intended.

The earliest account of the use of gypsum as a fertilizer in the ground form known as land plaster is in 1768, when a German clergyman, by name of Mayer, used it with success. After this time there were numerous experiments made to test its efficiency, and the faith of the workers along this line gave the appearance of wonderful results. Thus, one writes that "the invariable results of several experiments incontestably prove that there is a most powerful and subtle principle in this tasteless stone, but by what peculiar agency or combination it is capable of forcing vegetation in such an instantaneous and astonishing manner is a mystery which time reserves for others to unfold."

Varieties.

Gypsum in nature occurs in five forms, all of which are found in Kansas: 1. The earthy form, yellow or gray in color, and composed of loose, dust-like particles, rather light in weight, and formed from solution of gypsum in water. 2. The compact variety, including alabaster and massive gypsum, which is very soft and of specific gravity 2.2 or near. 3. Fibrous gypsum or satin-spar, usually found in thin layers, in the form of fine needles or prisms. 4. Foliated gypsum, sometimes massive, but usually in small concretionary masses. 5. Spar gypsum or selenite, found in transparent crystals.

Where Found.

Gypsum is found in Thuringia, Saxony, Norway, at Mont Martre, near Paris, in Austria, Bohemia, Italy, Egypt, Arabia, Persia, and many other places in the old country. In the United States it is found along an east and west line in cen-

tral New York, from Oneida county to Niagara; near Sandusky, Ohio; near Grand Rapids and Alabaster point, Michigan; in Smyth and Washington counties, Virginia; in Alabama and Louisiana; in Iowa, Kansas, Arkansas, Texas, Oklahoma, Indian Territory, Colorado, Montana, Utah, South Dakota, Wyoming, Arizona, Idaho, New Mexico, California. The total amount produced in the United States in 1894 was 239,312 short tons. The state of Kansas* produced that year 64,889 tons, of which all but 647 tons was calcined, thus standing second to Michigan among the states in quantity mined. The value of this product was $301,884, an excess of $112,264 over Michigan, placing this state first among the states of the union in value of gypsum products. The value of Kansas gypsum mined that year was greater than that of all the other states, excepting Michigan. There has been an increase in the value of the gypsum products of Kansas of $207,649 in six years, which makes a record the state may well be proud of, and at the present time a very small percentage of the available supply has been taken, so that Kansas gypsum has a promising future.

Location and Division of Area.

The gypsum deposits of Kansas occur in a belt trending northeast-southwest across the state. The belt of exposed rock varies in width from 5 miles in the north to 14 miles in the central part and 36 miles near the southern line, with a length of 230 miles.

This area is naturally divided into three districts, which are named from the important centers of manufacture: the northern or Blue Rapids area, in Marshall county; the central or Gypsum City area, in Dickinson and Saline counties; the southern or Medicine Lodge area, in Barber and Comanche counties. These areas appear to be separate; but careful mapping shows a number of isolated intermediate deposits which serve to connect at least two of the larger areas. Gypsum is reported from near Randolph and in the reservoir excavation at Manhattan, in Riley county. It is worked for plaster at Longford, in the southern part of Clay county; and it is found near Manchester, in the northern part of Dickinson county. These smaller areas indicate a connection between the northern and central areas.

Gypsum deposits of economic importance are reported from near Peabody, in Marion county, while they appear to be absent through Reno, Sedgwick, and Kingman counties, where the extensive salt deposits occur. There is thus a break between the central and southern areas which is occupied by salt deposits.

Geology.

The northern area is located in the Permian beds, consisting of fossiliferous limestones and shales. The central area lies in the Permian, though higher than the northern, while the salt measures to the south occur near the top of the Permian. The southern Kansas gypsum is found in a series of red, sandy shales, called the red beds, which probably mark the transition from the Permian to the Cretaceous. The deposits therefore rise geologically from north to south, but they are confined to the Permian formation. The deposits to the south in Oklahoma and Texas are placed in the Permian, while those at the north in Iowa are referred to the Cretaceous.

Topography.

The northern area shows the remnant of a plateau of 1,250 feet elevation, now indented by the Blue rivers and their tributaries, yielding a somewhat rugged topography. The central area lies 70 miles southwest of Blue Rapids. The

*Statistics from Sixteenth Annual Rep. U. S. Geol. Surv., 1896.

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area is drained by the Smoky Hill river, which flows in an extremely irregular or winding channel north of east, uniting with the Republican at Junction City, 30 miles away, to form the Kansas. It flows in the middle of a broad valley, 1,100 feet above sea-level and a mile or more in width. Its tributaries in the gypsum area are three or four small creeks — Gypsum, Holland, and Turkey — which flow almost directly north. The main watershed lies 22 miles to the south of the river, and trends nearly east and west, with an elevation of 1,500 to 1,550 feet. This descends on the south side within eight miles to 1,400 feet at the Cottonwood river. The divides between the north-flowing creeks have a gradual slope of about 20 feet to the mile, and their sides are deeply indented by erosion. They vary in height above the creek level from 100 to 150 feet. The effect is that of a dissected plateau with irregular surface. A number of small towns are situated along the railroads in the central part of the area, while the larger cities are located on the river.

The southern area is situated 120 miles southwest of Gypsum City. The northern part is drained by the Medicine Lodge river, which rises in Kiowa county and flows southeast to Medicine Lodge, where it abruptly turns south and flows into Oklahoma. There it empties into the Salt Fork of the Arkansas river. The southern part is drained by the Nescatunga and its branches. The streams have cut deep channels or cañons in the soft strata which reach 200 feet in depth. The watershed between the two rivers is broad in Comanche county, with an elevation of 2,200 feet, but it rapidly narrows to the southeast, in Barber county, where its elevation is 2,000 feet, descending to 1,600 feet in the valley of the Medicine Lodge river within a distance of seven miles. The watershed trends parallel with this river and turns south near the central part of Barber county, still parallel with the river. This region, with its gypsum-capped buttes of red clay and shale, possesses a very rugged topography and gives evidence of great erosion. These features are well shown in photographs of Flowerpot mound, and also in photographs of the gypsum hills near the town of Medicine Lodge.

Blue Rapids Area.

The first gypsum deposits worked in the state of Kansas were in the northern or Blue Rapids area. In November, 1869, the county commissioners laid out the site for the town of Blue Rapids. They carefully investigated the natural resources of the region and recognized the value of the water-power of the Blue, and also the value of the gypsum deposits which had been known for some time to exist on the Big Blue about two miles northwest of the town. On selling their various properties they made a reservation along the Blue of 100 rods, including the known outcrop of the beds and extending back from the river for a distance of 320 feet.

About the year 1871, Mr. J. V. Coon, of Elyria, Ohio, came to the new town, and, the story goes, he burned some of the gypsum and carried it back to Cleveland, where it was pronounced to be of good quality, and two car-loads were ordered at a good price. He and a brother returned to Blue Rapids in 1872 and built a frame shed on the east bank of the river, below the town. In an iron kettle, which held about five barrels, and which was heated by a stove, they commenced the manufacture of plaster of Paris. Prosperity seems to have attended their work, for in 1875 a stone mill was built by Coon & Son on the west bank of the river, and the water power of the river was now used for grinding. This mill is now standing — a monument to the commencement of a great Kansas industry. The town, for the purpose of encouragement of the new departure, granted them the north half of their reservation, described as extending from a

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point at the middle of the outcrop and thence north. This mill was operated for nearly 12 years, when the firm unfortunately failed. The mill property and the gypsum grant of 50 rods of outcrop and 20 rods back in the hill, came into the hands of Mr. Sweetland, a business man of Blue Rapids. It was leased to several parties, and the mill was run till the year 1889, when flood caused considerable damage, resulting in the abandoment of the mill.

Mr. Hayden, of New York, in 1887, bought the remaining portion of the old reservation and the adjoining Robinson farm. Fowler Bros. bought the farm back of the Sweetland 20-rods limit.

The earlier mining was done by stripping the cover of dirt and shales, and the rock was hauled in wagons to the mills. Later it was brought down the river in flat-boats drawn by a small steam tug.

In 1887 the Fowlers formed the Blue Rapids Plaster Company and built a one and one-half story frame mill, of one-kettle capacity, on the west side of the river, at the edge of the town. The present entry to the mine is 15 feet above the water level, though the gypsum bed-rock is the bed-rock of the river, which is four feet deep at this place. The entry runs east about 350 feet, and the gypsum dips west toward the river. Five men are employed at the mine, and the rock is hauled out and up an incline to the railroad, where a 25-ton car is loaded in two days and hauled to the mill. The gypsum occurs as a gray, mottled rock, with sugary texture, breaking with irregular fracture. The top consists of white selenite needles forming satin-spar, with a thickness of ¼ to 1¾ inches. Throughout the mine are numerous cutters, in which are found perfect transparent crystals of gypsum, usually of small size.

The Great Western mine is located on the side of a bluff, one mile north of the town and 45 feet above the level of the water in the river. It is 2¼ miles southeast of the Fowler mine. The entry runs east of north about 400 feet. In the first 200 feet the gypsum is in rounded masses, thick at the middle and running out on the sides, with the trend across the entry and parallel with the slope of the hill. These appear to be old water-courses. The thickness of the gypsum layer is the same as at Fowler Brothers' mine, 8½ feet, and both rest upon a limestone floor. The gypsum rock resembles very closely that already described, except there is an absence of cutters and crystals.

On the banks of the Little Blue, two miles west of town, is located the Winter mine. The entry runs east, and is in the hill about 900 feet. The rock does not differ in appearance from other parts of this area.

These three places are the only ones in the northern area where the rock is used; but it outcrops at a number of other localities, and is struck in the various wells to the north, south and west of Blue Rapids; but it appears to be absent in the wells to the east.

Gypsum City Area.

In the northern part of the area, six miles southwest of Solomon City, on Gypsum creek, is located the mill of the Crown Plaster Company. The workable stratum of gypsum is five feet, and is covered by 40 feet of shale and gypsum layers, which are much folded and broken. The entry is 20 feet above the water in the creek, and is driven 115 feet east, with two north entries 80 feet in length. The upper part of the stratum is similar to the northern gypsum, but the lower portion is very compact, and is dotted with elliptical crystals of yellowish-brown selenite, with the greater length in the direction of the vertical crystal axis. The crystals are nearly one inch long and one-half inch wide, and give an appearance somewhat of the bird's-eye limestone of the eastern United States.

At Hope, 20 miles southeast, is located the only other mine in the rock gyp-

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sum in the central area. This is owned by the Kansas Cement Plaster Company, and they now obtain the rock from a 14-foot stratum at the bottom of an 80-foot shaft. This rock is white, and much of it is traversed by wavy, dark lines, which give a gneissoid appearance, and the plaster made from it is sold under the name of "granite cement plaster." The lower part is compact, and contains the rounded crystals of selenite, as in the mine at the north. Through this region there is another stratum, five feet in thickness, and 100 feet higher, but it is not worked at the present time.

Secondary Deposits.

Most of the plaster mills of the central area use the earthy gypsum deposits, which occur at various places in the region. There are five of these known. The first of these was discovered in the spring of 1873, near Gypsum City, by Mr. John Tinkler, in running a fire-guard around a field. Two years later he calcined some of the dirt, as it is locally called, in an ordinary 38-gallon kettle and used the plaster in the cellar of his house, where it still remains in good condition. In 1889, he, with others, built a mill at the edge of town, but it is no longer used. The deposit covers an area of 12 acres, with an average thickness of eight feet. It consists of a loose, granular dirt, of light ash-gray color when dry, and is readily shoveled into cars. It is thus directly calcined with less labor and expense than is the case with the solid gypsum rock.

A number of years after the discovery of this deposit, Mr. Gotlieb Heller discovered a similar deposit 14 miles east, near Dillon station. Another deposit is located 3½ miles southwest of Dillon, and is five feet thick. In Marion county, about six miles south of the last deposit, the Acme Company own a mill and similar deposit which is 6 to 10 feet thick. The Agatite Company have another mill and deposit at Longford, in Clay county, 35 miles northwest of the Dillon mill.

All of these deposits lie in low, swampy ground, and strong gypsum springs are usually found in them. In most, there is a ledge of rock gypsum at the same level or 10 to 20 feet below. The presence of recent shells and bones near the bottom of these depesits shows they are recent in age.

Medicine Lodge Deposits.

The southern Kansas gypsum, with its continuation in Oklahoma and Texas, forms the largest area in the United States. Near Medicine Lodge the rock caps the hill as a layer 25 feet thick, protecting the underlying soft red beds, thus causing the very rugged topography already described. The red clays and shales below the gypsum contain interlacing network of selenite and satin-spar layers which have been dissolved out of the solid stratum and carried down by circulating water. In the western part of the area solution has carved out caves and underground channels, leaving, in many places, natural bridges of gypsum. The rock is snowy white, and the greater portion has a sugary texture, though the lower portion is compact. There are two mills making plaster of this rock. Best Brothers own a mill at the town of Medicine Lodge and manufacture the product known as Keene's cement or Robinson cement. This mill has been in operation since 1889. The Standard Cement and Plaster Company have a mill west of Sun City and manufacture about 18 tons of plaster per day. This great gypsum area is practically undeveloped at the present time.

Origin and Age.

I have treated this subject quite at length in a recent paper for the "Bulletin of the Geological Society of America," which will soon be issued from the press. The central and northern rock strata were deposited in an arm of the sea, cut off from the main ocean in the lower Permian or Neosho epoch. Farther out in the

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old gulf salt was deposited in large amounts, and forms to-day an important addition to the mineral wealth of the state. No salt is now found close to the gypsum, and if it did exist it has been removed by solution. The irregular upper surface of the gypsum shows that there has been solution in some places where large quantities of gypsum rock have been carried away.

The swamp deposits of earthy gypsum have probably been formed by deposits from springs, aided by wash from the hillsides, and they are recent in age.

The southern gypsum was deposited in a shallow gulf cut off not far from the close of the Permian time. As in the northern gulf, a salt deposit occurs to the southwest in the salt-plains district; but no trace is found near the gypsum.

THE STUDY OF NATURAL PALIMPSESTS.

By G. P. GRIMSLEY, Topeka, Kan. Read (by title) before the Academy January 2, 1897.

Paleontology has revealed a long life-history from Cambrian time to the present, and has vainly attempted to read the obscure pages of earlier history of Archæan time. Baffled at every turn, the search was abandoned; but a new science has boldly entered the field, and the mysterious pages furnish a history for the petrographer, which in interest rivals that of the paleontologist.

This record is not written in fossil letters, but in mineral characters, which so long have been meaningless geoglyphics. In making the so-called prehistoric record, nature has been economical in materials and in space. She has erased some portions of the ancient record with the cleansing force of fire, rewriting on the same tablets of stone the records of new conditions.

The discovery that many of the records of ancient historical time were written on erased parchments of an earlier day, and that a careful investigation would reveal many of the first records, was a historical triumph. The students of ancient languages have enriched the world by their painstaking search through old literary palimpsests. In the past decade the students of nature have discovered the existence of *natural palimpsests*, and they are now endeavoring to read the imperfectly erased records of the past, and thus add new chapters to the history of the earth. To the process of erasure and rewriting these investigators have given the name *metamorphism;* and the natural palimpsests are called *metamorphic rocks*.

The studies of biologists have shown that throughout organic nature there is a most delicate adjustment to environment. The researches of petrographers have shown that in the inorganic world minerals are so delicately adjusted to surrounding conditions that changes in the latter are recorded by variations in the minerals. The recognition of this fact in recent years is the foundation of the new knowledge concerning the Archæan period.

According to the Wernerian theory of the last century, crystalline rocks were deposited as chemical precipitates from a primeval heated ocean before life existed. They were produced at their origin as they exist to-day. Near the close of the century, Hutton found granite dikes penetrating other rocks, thus proving an igneous origin. He then advanced farther and formed the interminable cycle, stating that rocks were decomposed by atmospheric action, the detritus accumulated at the bottom of the sea, where under the pressure and heat it was rendered crystalline, and later elevated to pass through the same series of changes without trace of beginning or prospect of end. The theory of the transformation of rocks under heat and pressure originated at this time in this rudimentary form in Scot-

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land. Bone and Necker, nearly a quarter of a century later, transported the theory from this Plutonic region to Europe, where it reached greater development. The Alpine region, on account of the great forces at work and the gradations in effects, from the simple to the complex, soon became a classic region for the study of rock alterations. In 1826 Beaumont recognized that in this region the phenomena were not confined to the oldest rocks. He observed that Jurassic fossil sediments had been changed to crystalline rocks. The old Alps now became the new Alps, and the interest in the region was greatly increased.

In the process of adjustment of the minerals or rocks to changes in their environment, new elements are often added and old ones removed. If the changes take place at the surface of the earth, under ordinary atmospheric or aqueous influences, they are included under the term *weathering*, and the result is usually disintegration. True metamorphism is connected with igneous and dynamic agencies; and while the word was first introduced by Lyell, in 1832, it was not clearly defined until 1846, when Durocher described metamorphism as the sum total of all modifications in texture or structure to which rocks in nature are subjected. Daubrée limited the definition to those modifications whose causes were fire and water, and Beaumont added the agency of mineralizers. The word *metamorphism* is now cosmopolitan, though given different limitations by different authorities.

American geologists from an early day have been prominent in this field of study. The pioneers composing the American metamorphic school — Hitchcock, Mather, Dana, Logan, Rogers brothers — were active students of those altered records, and they made many valuable observations. They all regarded the process of metamorphism as confined to the sedimentary rocks, a view which long retarded progress in the work. When foliated or parallel structures were observed in metamorphic rocks, they were regarded as the old sedimentary lines which survived the alteration. A voluminous literature descriptive of this limited field of altered sediments soon filled the shelves of science.

Down to the year 1875 the province of metamorphic action was thus confined to the sedimentary rocks. About this time appeared the epoch-making works of Heim, in the Alps, and of Lossen, in the Hartz, whereby it was shown that igneous rocks could be changed by metamorphic action.

On account of the interesting and inviting problems connected with this study, it has attracted the attention of many of the younger workers; and the result has been a very great advance in our knowledge of these broken and crumpled rocks, though the vast field yet remains practically unexplored.

Metamorphism may refer to any changes in rocks, but it is restricted now to include the changes whose conditions lie intermediate between fusion and ordinary atmospheric action. The limits are not sharply defined, so metamorphism grades below into igneous action, and above into atmospheric action or weathering. Metamorphic rocks may be further metamorphosed, so that all rocks, sedimentary, igneous, and metamorphic, are subject to metamorphism. The agencies at work in this great process are both physical and chemical; and they are classified according to the preponderating influence. If the temperature and pressure are low the action is due mainly to water, producing *hydro-metamorphism*, resembling very closely weathering. If temperature is high and pressure is low, and mineralizers — gases whose presence facilitates fusibility — are present, the action is described as *sublimation metamorphism;* or, if water alone be present, the action is described as *thermo-metamorphism*. Static metamorphism includes those changes where pressure is mainly active and where motion is absent. If motion is present, the changes come under the division of dynamic

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metamorphism. All of these alterations take place without any material change in the bulk composition. Static metamorphism, though not accepted by many geologists, has able defenders in such men as Hall, Judd, and Spring. Dynamic metamorphism has been firmly established by the classic works of Heim, Lehman, and Balzer.

Metamorphism may be produced by the presence of some metamorphosing agent, and it is then termed *contact metamorphism*. The alteration in surrounding rocks may extend over a distance from a small fraction of an inch up to 4,000 feet, as seen in the Pyrenees. The nature of the contact metamorphism depends on the duration of the action, the depth at which the alteration takes place, whether deep enough to prevent the escape of vapors and moisture, or not; and on the nature of the metamorphosing agent, whether it is a granite, diabase, or other rock; and also on the nature of the rock altered, whether crystalline schists, carbonaceous rocks, sandstones, or igneous rocks. The nature further depends on the structure of the rocks, whether foliated or not, as demonstrated in Brittany by Barrois.

Rosenbusch, after careful examination of analyses, concludes that there is no change in the bulk composition of the altered rocks, though Michel Levy insists that there is always a very considerable addition of substance.

The effect of contact metamorphism on crystalline schists is less intense than on most of the rock types. The effects, consisting mainly of the formation of new minerals, as andalusite, sillimanite, and garnets, have been described in the Cortlandt rocks by the late Dr. G. H. Williams. The effect of this form of metamorphism on carbonaceous shales is to form a graphite, or the diamond, as in the South African region. The effects of contact action on clay slates have been described at a number of regions which serve as types: at Barr Andlau, in Germany, by Rosenbusch, by Lossen in the Hartz, by Allport and Phillips in England, by Barrois in Brittany, by Brögger in Norway. In these various regions it has been noted that the intensity of metamorphism at any given point is proportional to the nearness of the intruding rock.

In limestone contacts the conditions are very favorable for the tracing of the beginning and development of the metamorphism. The limestone is observed to become more and more crystalline as the intrusive rock is approached and the carbonates change to silicates. These changes are observed in the well-known limestone contact region near Christiania, Norway, and the famous mineral locality of the Fassathal, in the Tyrol. Contact action on igneous rocks has been observed at but few places. It has been described by Lossen in the Hartz mountains.

The pioneer in the study of dynamic metamorphism was Lossen in 1867. In 1878 Heim published his great work, the result of a long field-study of the Alpine rocks, in which he developed the theory that even the most brittle rocks under pressure acted as viscous bodies, and were deformed without rupture. Spring and Guembel endeavored to prove this theory by actual experiment, but the rocks were crushed to a fine powder.

In 1884 Lehman, as a result of microscopical study of the crystalline schists of the Alps, concluded that the rocks were crushed and recemented under great pressure, thus producing an effect similar to viscous bodies, a process which might be described as rock regelation. These two works marks a new phase in the study of metamorphism the world over, through the recognition of the fact that *foliation* in rocks is wholly independent of original structure. Parallel arrangement in rocks is not proof of sedimentation, a view which before this time was not recognized.

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Heat, water, and pressure are great agents of metamorphism, and they produce three kinds of alterations in rocks — mineral, microstructural, and macrostructural changes. Under mineral changes, we have among the alkaline silicates the alteration termed *sericitization*, forming an intercalating network of hydromicas. Also *saussuritization*, embracing the changes whereby plagioclase feldspar is converted into alkaline earth silicates. In *albitization* the feldspar is changed into an interlocking albite mosaic. Among the iron-magnesian silicates occurs: *uralitization*, where pyroxene is changed into fibrous hornblende; *viridization*, or formation of green epidote chlorite mass, analogous to saussuritization; *chloritization*, and *epidotization*, analogous to albitization.

Under microstructural changes are observed the strain phenomena in crystals, recognized by polarized light in a wavy extinction of light as the section is rotated. If the strain has been carried farther, gliding or twin lamellæ may be observed, as in the metamorphic marbles. Progressing to greater extent, the minerals are bent, twisted, and finally broken into an irregular mosaic, composed of interlocking mineral grains. Sometimes there is a stretching of the rock along certain lines, pulling the grains apart.

Under macrostructural changes, the most prominent is the formation of secondary foliation, or an arrangement of the minerals along parallel lines, which were so long taken as evidence of stratification. Though this distinction between foliation and sedimentary lines was noted early in the century by Voigt, Mohs, and Schmidt, it attracted little attention. Later it was observed that the lines were parallel over extensive tracts, even when the rocks were crumpled. This was explained as the result of crystalline force or the result of electric currents passing around the earth. In 1846 it was shown to be due to pressure normal to that which developed the foldings.

Such rocks, which possess this secondary foliation, are called *crystalline schists*. This is purely a structural term and has no connection with age. While most of these rocks are pre-Cambrian, there are numerous exceptions. The schists are divided into two main groups, those with feldspar and those without this mineral; and the former are called *gneisses*. This usage makes gneiss a mineralogical and structural term; mineralogical in that it contains feldspar, structural in that it is foliated. If the origin of the gneiss is determinable it has the original rock name added as a prefix. Thus, a secondary foliated conglomerate is called a conglomerate gneiss. A foliated granite is a granite gneiss. When the word *gneiss* is used alone it represents a foliated feldspathic schist of unknown origin.

Down to the end of the last century geology was a collection of hypotheses and sacred theories of the earth. Its students then began to observe and record facts, and later to form theories based on such observed facts. The study of the igneous rocks passed through a similar course of development. The study of the metamorphic rocks is now passing through such a course and it has entered the descriptive stage. It is now at the point reached by general geology in the time of Lyell, and reached by the study of the igneous rocks in the year 1870.

The study of the crystalline schists, both of Archæan and post-Archæan time, now becomes the great field for work, and all over the world students are trying to trace their origin and formation.

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IN MEMORIAM.

ROBERT HAY.

By A. H. THOMPSON, Topeka.

Robert Hay was born May 19, 1835, at Ashton-under-Lynn, in Lancashire, England, and died December 14, 1895, at Junction City, Kan.

He came of Scottish ancestry, and acquired his primary education in private schools in his native town, completing it in the College of London, where he pursued a special scientific course under Professor Huxley, and took honors.

Through reading the *Junction City Union*, and then as correspondent, he left England and came to Kansas in 1871, and settled on a farm in Geary county.

He taught school for ten years and was engaged in normal-institute work from its inception in the state. He first taught at Ogden, Kan., as principal, and as principal also at Holton and Chetopa, Kan.

Although the first years of his manhood were devoted to teaching, he early became interested in geology, which he later made his life-work. Even before leaving England he familiarized himself with the geology of his own and adjacent counties during his long vacation walks.

After removing to Kansas, he gradually acquired a local knowledge of the geology of Kansas, and as a field geologist he traveled for three years over Kansas. It was said that there was hardly a township in Kansas that he had not visited. He was connected with the State Board of Agriculture as its geologist, and did much valuable work for the board, which is embodied in his articles published in the reports. His work was practical, and tended toward the development of the natural resources of the state, in which he was always interested. In 1883 he was employed by the United States Geological Survey in the southwestern part of Kansas, and afterward for years on special commissions for the survey. In 1890 he was made geologist in charge of the artesian investigation of the great plains region conducted by the Department of Agriculture. A large and valuable report resulted from these labors. During the last year of his life he was employed to write a special report on the underground waters of western Kansas for the United States Geological Survey.

He enjoyed a wide reputation for accomplishments and ability; and the honesty and modesty of the man gave his opinions great weight. They were highly valued by government officials as well as by other scientific men who knew his real worth. He was one of the foremost of that noble band of patriot naturalists who have done so much for the investigation and description of the scientific resources of Kansas. He followed close in the footsteps of the first and greatest of that band, Professor Mudge; and he resembled that noble pioneer in many ways. The quantity and quality of his geological observations are ample evidence of the industry and perseverance of Professor Hay, often through difficulty and discouragement, with inadequate compensation, which all testify to his love and devotion to his special work.

His literary work was very extensive. He early showed his literary tendencies by writing a volume of sketches of his native region in Lancashire before leaving England. He was a voluminous contributor to Kansas newspapers, not on geology only, but on Kansas history and other matters as well. It was while

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teaching in the higher grades of schools that he became interested in the geology of Kansas; and among his earlier writings on his favorite science was a pamphlet issued while conducting a teachers' institute in Norton county, embodying his observations on what he called the "Sunset Rocks." His contributions to the newspapers and magazines on geology and to the State Board of Agriculture and Academy of Science were very numerous. He conducted investigations for the Academy which are of permanent worth as geological work, the results of which are published in the Transactions.

For many years of his life he had a helpful companion in his wife, a lady of unusual literary and artistic merit, who was deeply interested in and associated with her husband's labors. She died about five years ago. Most of his papers were illustrated by her hands.

A list of his articles is appended to this sketch, prepared by Miss Jean Hay, the daughter of Professor Hay.

The personal character of the man made him esteemed by all who knew him. As has been said, "He was a scientist, a man of high literary culture, a close student, a gentleman in all that the name implies, and a citizen of more real worth than many have appreciated." It is the character that is the real foundation of life, and that upon which we most love to dwell in thinking and speaking of our departed friends. In a peculiar manner the character of Robert Hay was such that his good and noble qualities could not be overestimated or exaggerated, which can be said of few men. What we remember most about him is his goodness and gentleness; for, as he walked he scattered the fragrance of a kindly heart that lingers with us still. He was the personification of gentleness, and bound all hearts to him by the quiet demeanor that betokened the love he felt for all mankind.

It could be said of him, as Carlyle said of Scott: "There is no life of a man, faithfully recorded, but it is a heroic poem, rhymed or unrhymed;" for truly the life of Robert Hay was an unrhymed, heroic poem. Simple and self-sacrificing; undergoing privations; with insufficient compensation and little hope of reward —such was his life, that he might pursue and contribute to his favorite science. He was one of the heroes of the commonplace — the martyrs of our daily life — who suffer, and strive, and fall and make no sign. His was that steadfastness to an ideal which makes heroes in an every-day life. He worked with painstaking zeal and patient abiding, through failure and disappointment, with slow and painful effort; and failed but to begin again. That is the spirit of true heroism; for he steadily upheld his ideal with the courage and faith that fought and overcame; that endured and suffered to the end.

He was what we call a *wise* man — for he had in full share that wisdom which holds that the knowledge of the truth is valuable above all else for its influence upon character. For wisdom is better than learning. The wisest man is not he who falls into the fewest errors, but he who has made the best use of what knowledge he had, be it much or little, for the growth of character and the good of mankind. In this sense Robert Hay was essentially a wise man in the wisdom that makes for what is best in the world.

One phase of his life with which not many were acquainted, was his exquisite literary tastes and accomplishments. His reading and acquaintance with the best authors were wide and varied. His speaking and writing on literary subjects were marvels of beauty and quaintness of expression. He was especially conversant with the Victorian poets, and could talk by the hour most delightfully and learnedly of the literature of this period. His memory was wonderful, and he could recite at length from the masterpieces in a most charming manner. He could

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give the native touch to the dialect poems of Tennyson in a manner that was inimitable. One of his most charming letters, amounting to an essay of real literary merit, received a short time before his death, was upon the Arthurian legends. One of his last, if not the very last, literary efforts, was a lecture for the Keats Centenary, October 29, 1895, which was full of information about the poet and his times. It was charmingly written; but was never delivered in public, I believe, as his illness began before the occasion arrived. In his untimely death we are reminded of those beautiful lines in Shelley's "Adonais":

"Peace, peace, he is not dead;
He doth not sleep;
He hath awakened from the dream of life."

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JAMES H. CARRUTH,

By E. H. S. Bailey and B. B. Smyth.

James H. Carruth was born in Phillipston, Mass., February 10, 1807. He died at Van Buren, Ark., September 14, 1896, after an illness of only four days. He was always in fair health, and till near the end of his long life was lively and cheerful as when 20 years younger.

Professor Carruth was of Scotch-Irish descent. His ancestors settled in Massachusetts about 1740. He studied at Amherst, Mass., near his home, and afterward went to Yale, where he took a classical course and graduated in 1832. At the time of his death he was one of the few of his class still living.

He studied theology at Auburn Theological Seminary, and was given a license to preach in the Presbyterian church. He taught and preached for some little time in various towns in New York, especially Watertown and Cherry Valley.

He was married to Jane Grant, the mother of all his children, in 1841. In 1856 he came to Kansas and helped to make Kansas a free state. He was here through the troublous times of this state's history. At first he lived on a claim near Osawatomie, but after a few years was elected to the professorship of natural sciences at Baker University, Baldwin. Here he served three years; then moved to Lawrence, where he lived for 25 years. In the meantime he was lecturer on botany at Washburn College for a year or so. In 1875 his wife died. While in Lawrence he preached at Clinton and other places occasionally as a supply.

A few years before his death he left Lawrence and went west, and afterward south.

At an early age he developed a taste for botany, and in 1868 was elected to the position of state botanist, which position he held until he left the state in 1892. For many years he was the highest authority in the state on this subject.

He was a constant collector of plants. He made many trips over the state, entirely at his own expense, collecting plants either for his own herbarium or to fill orders from colleges east. He collected up to the last year of his life, largely in New Mexico, Indian Territory, and Arkansas. In 1872 he published a catalogue of the plants of Kansas, in Vol. I of the Transactions of the Kansas Academy, with supplementary lists in succeeding volumes. In 1876 he published a "Centennial Catalogue of the Plants of Kansas," embracing 1,082 species; to which additions were made from year to year until 1884, increasing the number of Kansas plants to 1,515 species. These additions were published in this Academy's Transactions.

He was one of the organizers of the Kansas Academy of Science in 1868; attended its first meeting, that year, and was a constant worker in the Academy up to 1890. He was a vice-president of the Academy from 1875 to 1881.

In 1893, at the annual meeting held at Emporia, he was elected to a life membership in the Academy in token of his botanical labors for the state of Kansas.

He did considerable work on phonetics also, and was the originator of a number of very interesting theories on this subject. He published a history of Sequoyah, or George Guess, and gave a synopsis of Sequoyah's efforts in constructing an alphabet for the Cherokee nation.

Professor Carruth, though a man of great learning, was exceedingly modest, and this self-depreciatory nature, while helping to win for him many warm

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friends, to some extent prevented his obtaining position worthy of his attainments. His former pupils love and revere his memory.

He was married a second time, in 1883, to Mrs. Mary E. Pedrick, who survives him. She resides at Van Buren, Ark.

He left four sons and one daughter. The funeral services were conducted by Revs. A. M. Richardson and W. G. Banker, and the remains were buried in Oak Hill cemetery, Lawrence.

Following is appended a list of his writings, as far as obtainable at this time:

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REPORT OF LIBRARIAN.

Submitted January 2, 1897.

I have the honor of presenting the following report: The number of books and pamphlets received during the past two years was 1,095, a slight falling off from the previous two years in number; but, taken all together, a slight increase in value, partly from the reception of exchanges from scientific institutions which exchange ordinarily their publications only with the most prominent scientific societies and principal libraries. Among these societies may be named the Belgian Society of Geology and Paleontology, the Finnish Scientific Society, Society for the Fauna and Flora of Finland, the Mathematical Society of Kazan, and the Imperial Academy of Sciences of St. Petersburg. The publications of all these societies are voluminous, beautiful in typography, profuse and accurate in illustration, and compare favorably with the best American publications.

The number of bound books was 213, which is nearly the same as received during the previous two years.

The number of letters written during the past two years was 1,674, of which about three-fifths were written during the past year. This does not include mimeograph circular letters, of which there have been hundreds prepared and sent out. The first three volumes of the Academy Transactions have been reprinted at the expense of the Academy. Five hundred copies were printed. Fourteen copies have been sold to members at 50 cents each. Nearly 100 copies have been sent to exchanges which were entitled to them, leaving nearly 400 copies on hand. Members who have paid their dues to the Academy think they are entitled to copies of these three volumes without further payment. Your librarian has refused such requests. The disposal of the remaining copies is respectfully referred to the Academy. I await instructions. I have the pleasure to state that the binding of 500 volumes of unbound exchanges has been ordered by the State Executive Council. Two hundred of them are already bound, and 300 more are in the state printer's hands. I submit herewith a list. The use of the library by members of the Academy outside the city has been greatly increased during the past year. Nearly 150 volumes have been taken out.

The appropriation made for the Academy by the state legislature has greatly increased the working ability of your librarian. Attention can be given more promptly to correspondence.

A list of accessions to the library during the past two years is also submitted.

B. B. SMYTH, *Librarian.*

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FROM JANUARY 1, 1895, TO DECEMBER 31, 1896.

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Dimensions of books when given are in centimetres, breadth and length; when not given are usually octavo, or about 14–15 x 20–23 centimetres.

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The California Phryganidian, by Vernon L. Kellogg and J. Jack, Proc. Calif. Acad. Sci., VI, pp. 562–570; pl. LVI.

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No. 7. Chart, 60 x 90 cm., showing by counties the mineral products of California for 1894, by Charles G. Yale.

No. 8. Chart, 60 x 90 cm., showing by counties the mineral products of California for 1895, by Charles G. Yale.

No. 9. On mine drainage, pumps, etc., by Hans C. Behr, 210 pp.; 206 figs.

No. 10. A Bibliography relating to the geology, palæontology, and mineral resources of California, by Anthony W. Vogdes, 121 pp.

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Notes on the precipitation of the precious metals from cyanide solution by means of zinc; the non-existence of cyanide of zinc, in alkaline solutions, by Nicholas Anderson, 4 pp.

Occurrence of Tellurium in oxidized form, associated with gold, by Richard Pearce, 4 pp.

Volcanic rocks of Alum Hill, Boulder county, Colo., by C. Irving Andrews, 8 pp.

Notes on the occurrence of uraninite in Colorado, by Richard Pearce, 3 pp.; 1 fig.

Dike on the Columbia vein in Ward district, Boulder county, Colo., by Chas. Skeele Palmer, 6 pp.; 1 fig.

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The technical determination of iron, by L. J. W. Jones, 14 pp.

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Publication 5. Zoological series, Vol. I, No. 1. On the structure and development of the vertebral column of *Amia*, by O. P. Hay, 62 pp.; 3 colored plates.

Publication 6. Report series, Vol. I, No. 1. Annual report of the director to the board of trustees for the year 1894-'95, 80 pp.

Publication 7. Zoological series, Vol. I, No. 2. On certain portions of the skeleton of *Protostega gigas*, by O. P. Hay, pp. 55-96; pll. IV and V.

Publication 8. Anthropological series, Vol. I, No. 1. Archeological studies among the ancient cities of Mexico, by Wm. H. Holmes, 138 pp.; 18 pll.; 41 figs.

Publication 9. Botanical series, Vol. I, No. 2. Flora of West Virginia, by Charles Frederick Millspaugh and Lawrence William Nuttall, pp. 65-276; pll. V-VII.

Publication 10. Ornithological series, Vol. I, No. 1. Contribution to the ornithology of San Domingo, by George K. Cherrie, 26 pp.

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Publications 12 and 13. On some collections of fishes and on the skeleton of Toxochelys latiremis, by O. P. Hay, pp. 85-106; 2 pll.

Publication 14. Annual report of the director to the board of trustees for the year 1895-'96, pp. 84-106.

University of Chicago—Department of Geology: Journal of Geology, semi-quarterly, about 120 pages each. Vol. III, 1895, 1004 pp.; 10 pll.; and numerous figures and views. The basic massive rocks of the Lake Superior region, by W. S. Bayley, part V, pp. 1-20; figs. 1-4. A petrographical sketch of Ægina and Methana, by Henry S. Washington. Part II, pp. 21-46, 133-168; 2 diagrams. Lake basins created by wind erosion, by G. K. Gilbert, pp. 47-49. On Clinton conglomerates and wave marks in Ohio and Kentucky, by Aug. F. Foerste, pp. 50-60, 169-197. Glacial studies in Greenland, by T. C. Chamberlin, pp. 61-69, 198-218, 469-480, 565-582, 668-681; pl. IV; figs. 15-16, 17-22, 23-30, 31-42, 43-51; 1 map. Studies for students: Agencies which transport materials on the earth's surface, by Rollin D. Salisbury, pp. 70-97. Sedimentary measurement of cretaceous time, by G. K. Gilbert, pp. 121-127. Use of the aneroid barometer in geological surveying, by C. W. Rolfe, pp. 128-137; pll. I-III. The classification of European glacial deposits, by James Geikie, pp. 241-269. The classification of American glacial deposits, by T. C. Chamberlin, pp. 270-277. The variations of glaciers, by Harry Fielding Reid, pp. 278-288. Stratigraphy of the Saint Louis and Warsaw formations in southeastern Iowa, by C. H. Gordon, pp. 289-311; pl. V; figs. 1-6. Algonkian rocks of the Grand Canon of the Colorado, by Charles D. Walcott, pp. 312-330; pl. VI; fig. 1. New light on isostasy, by G. K. Gilbert, pp. 331-334. Studies for students: James D. Dana, as a teacher of geology, by Oliver C. Farrington, pp. 335-340. Mesozoic changes in the faunal geography of California, by James Perrin Smith, pp. 369-384. The age and succession of the igneous rocks on the Sierra Nevada, by H. W. Turner, pp. 385-414; pl. VII; figs. 1-3. The stratigraphy of the California coast ranges, by H. W. Fairbanks, pp. 415-433. Studies in the Neocene of California, by George H. Ashley, pp. 434-454; pll. VIII-X. Some cretaceous beds of Rogue river valley, Oregon, by F. M. Anderson, pp. 455-468; 4 sections. Studies for students: Geologic study of migration of marine invertebrates, by James Perrin Smith, pp. 481-495. Notes on the glacial deposits of southwestern Alberta, by George M. Dawson, pp. 507-511. Experimental application of the photo-topographical method of surveying to the Baird glacier, Alaska, by Otto J. Klotz, pp. 512-518. The cambro-silurian question in Missouri and Arkansas, by C. R. Keyes, pp. 519-526. Notes on the examination of a collection of interglacial wood from Muir glacier, Alaska, by F. H. Knowlton, pp. 527-532; fig. 1. Lake Passaic: An extinct glacial lake, by R. D. Salisbury and H. B. Kummel, pp. 533-560; map of Lake Passaic. Description of a new species of Petalodus (P. securiger) from the carboniferous of Illinois, by O. P. Hay, pp. 561-564; figs. 1 and 2. James Dwight Dana, and his work as a geologist, by Henry Shaler Williams, pp. 601-621. Glacial and interglacial deposits near Toronto, by A. P. Coleman, pp. 622-645; 2 cuts. Origin of certain features of coal basins, by H. Foster Bain, pp. 646-654; figs. 1 and 2. Preglacial gravels on the quartzite range near Baraboo, Wis., by R. D. Salisbury, pp. 655-667. The classification of the upper palæozoic rocks of central Kansas, by Charles S. Prosser, pp. 682-705; 2 illustrations. The Greenland expedition of 1895, by Rollin D. Salisbury, pp. 875-902. A circuminsular palæozoic fauna, by S. Weller,

pp. 903-917; 1 cut. Experiments in ice motion, by E. C. Case, pp. 918-934; figs. 1-11. Absarokite-Shoshonite-Banakite series, by Joseph P. Iddings, pp. 935-959; 1 diagram. Distribution of gold deposits in Alaska, by Geo. F. Becker, pp. 960-962.

Vol. IV, 1896, Nos. 1-4, 528 pp.; 7 pll.; numerous figures. Review of the geological literature of the South African Republic, by S. F. Emmons, pp. 1-22. Igneous intrusions in the neighborhood of the Black Hills of Dakota, by Israel C. Russell, pp. 23-43; pll. I-III. The geology of New Hampshire, by C. H. Hitchcock, pp. 44-62. North American graptolites, by R. R. Gurley, pp. 63-102, 291-311; pll. IV and V. Kame areas in western New York south of Irondequoit and Sodus bays, by H. L. Fairchild, pp. 129-159; figs. 1-7. A pretertiary nepheline-bearing rock, by F. Bascom, pp. 160-165. Petalocrinus mirabilis (n. sp.) and a new American fauna, by S. Weller and R. A. Davidson, pp. 166-173; pll. VI and VII; figs. 1 and 2. Remarks on Petalodus alleghenieusis, by Charles R. Eastman, pp. 174-176. On the nature of igneous intrusions, by Israel C. Russell, pp. 177-194; 1 cross-section. Studies for students: Deformation of rocks, by C. R. Van Hise, pp. 195-213, 312-353, 449-483; figs. 1-6, 1-19, 1-11. The magmatic alteration of hornblende and biotite, by Henry S. Washington, pp. 257-282. On the origin of the Chouteau fauna, by Henry Shaler Williams, pp. 283-290. Classification of marine trias, by James Perrin Smith, pp. 385-398. The geology of the Little Rocky Mountains, by Walter Harvey Weed and Louis V. Prisson, pp. 399-428; figs. 1-3. Schistosity and slaty cleavage, by George F. Becker, pp. 429-448; figs. 1-5. Large scale maps as geographical illustrations, by W. M. Davis, pp. 484-513.

SPRINGFIELD.—*Illinois State Museum of Natural History, Wm. F. E. Gurley, State Geologist:* Bulletin No. 7. New and interesting species of palæozoic fossils, by S. A. Miller and Wm. F. E. Gurley, 90 pp.; 5 pll.

Bulletin No. 8. Description of new and remarkable fossils from the palæozoic rocks of the Mississippi valley, by S. A. Miller and Wm. F. E. Gurley, 66 pp.; 5 pll.

Bulletin No. 9. New species of crinoids from Illinois and other states, by S. A. Miller and Wm. F. E. Gurley, 66 pp.; 5 pll.

Bulletin No. 10. New species of echinodermata and a new crustacean from the palæozoic rocks, by S. A. Miller and Wm. F. E. Gurley, 92 pp.; 5 pll.

Bulletin No. 11. New species of palæozoic invertebrates from Illinois and other states, by S. A. Miller and Wm. F. E. Gurley, August, 1896, pp. 1-50; 5 pll.

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BROOKVILLE.—*Amos W. Butler, Indiana Academy of Science:* Constitution, by-laws, officers, and list of members, 1886, 12 pp.; 1887, 12 pp.

INDIANAPOLIS.—*Department of Geology and Natural History:* Eighteenth annual report, S. S. Gorby, state geologist, 1893, 356 pp.; 2 maps; 17 sections; 12 pll. Introductory: The coal industry, building stone, Indiana clays, sand, natural gas, and petroleum, by S. S. Gorby, pp. 9-16. The geology of Noble county, by Charles R. Dryer, pp. 17-32. Flora of Noble county, by W. B. Van Gorder, pp. 33-71. Report upon the geology of Lagrange county, by Charles R. Dryer, pp. 72-82. The drift of the Wabash-Erie region — a summary of results, by Charles R. Dryer, pp. 83-90; 1 map. Report of inspector of mines, by Thomas McQuade, pp. 91-189. Report of state supervisor of oils, by N. J. Hyde, pp. 190-195. Report of state supervisor of natural gas, by E. T. J. Jordan, pp. 196-218. Indiana's structural features as revealed by the drill, by E. P. Cubberly, pp. 219-256; 1 map; 17 sections. Palæontology, by S. A. Miller, pp. 257-356; pll. I-XII.

Nineteenth annual report, 1894, S. S. Gorby, state geologist, 296 pp. Geology of Cass county, by M. N. Elrod, M. D., and A. C. Benedict, pp. 17-48. Report of inspector of mines, by Thos. McQuade, pp. 49-111. Report of state supervisor of oils, by N. J. Hyde, pp. 112-122. Report of state supervisor of natural gas, by E. T. J. Jordan, pp. 123-145. The lampreys and fishes of Indiana, by O. P. Hay, pp. 146-296.

Twentieth annual report, W. S. Blatchley, state geologist, 520 pp.; 16 pll.; 4 maps; 23 figs. Introductory, consisting of notes on the natural fuels of the state, and resources other than fuels, pp. 5-22. A preliminary report on the clays and clay industries of the coal-bearing counties of Indiana, by W. S. Blatchley, pp. 23-185; pll. I-VII; 1 fig. The carboniferous sandstones of western Indiana, by T. C. Hopkins, pp. 186-327; pll. VIII-XVI; figs. 1-7; 2 maps. The whetstone and grindstone rocks of Indiana, by Edward M. Kindle, pp. 329-368; 1 map. Report of the state natural gas supervisor, J. C. Leach, pp. 369-410; 1 map. Report of state inspector of mines, Robert Fisher, pp. 411-460. Report of the state supervisor of oils, by Nelson J. Hyde, pp. 461-466. Report of state supervisor of oils, by C. F. Hall, pp. 467-474. The crawfishes of the state of Indiana, by W. P. Hay, pp. 475-506; figs. 1-16.

Botanical Department: Report of the botanical department, by J. C. Arthur (extract from the eighth annual report of the Indiana Agricultural Experiment Station for 1895), pp. 21-28.

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LAFAYETTE.— *Purdue University:* Agricultural Experiment Station: Bulletin No. 59. Vol. VII, March, 1896. Bacteriosis of carnations, 40 pp.; 8 pll. (2 colored).

Arthur, J. C., Author: Delayed germination of the cocklebur and other seeds, by J. C. Arthur, pp. 70-79.

Deviation in development due to the use of unripe seeds, by J. C. Arthur, pp. 804-813.

Distinction between animals and plants, by J. C. Arthur, pp. 961-965.

Report of the botanical department, by J. C. Arthur, pp. 21-28.

Development of vegetable physiology, an address before the American Association for the Advancement of Science, by J. C. Arthur, pp. 1-24.

Bacteriosis of carnations (Purdue University Agricultural Experiment Station), by J. C. Arthur and H. L. Bolley, pp. 17-38; 8 pll.

Botanical papers by J. C. Arthur: 1. Some algæ of Minnesota, supposed to be poisonous. 2. Description of Iowa uromyces, pp. 1-37.

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AMES.—*Iowa Academy of Science* (see Des Moines).

Iowa Agricultural College Experiment Station: Bulletin No. 28, pp. 155-238; 6 pll.; 8 figs. No. 29, pp. 239-286; 5 pll.

L. H. Pammel, Iowa Agricultural College Experiment Station: Diseases of plants at Ames, 1894, by L. H. Pammel, pp. 201-208.

Distribution of some weeds in the United States, especially Iva xanthiifolia, Lactuca scariola, Solanum carolinense, and Solanum rostratum, by L. H. Pammel, pp. 103-128.

Pollination of cucurbits, by L. H. Pammel and Alice M. Beach, pp. 145-152; pll. XI-XIV.

DAVENPORT.—*Academy of Natural Sciences:* Elephant pipes in the museum of the academy of natural sciences, by Charles E. Putnam, 1885, 40 pp.; 1 cut.

Proceedings, Vol. VI, 1889-'97, 392 pp.; 6 litho. pll.; numerous figs.

DES MOINES.—*Iowa Academy of Sciences:* Proceedings, Vol. II, 1894, 226 pp.; 22 pll.; 2 figs. Contains the following papers, or abstracts of them: Recent advances in the theory of solutions, by Launcelot W. Andrews, pp. 13-19. Interloessial till near Sioux City, Iowa, by J. E. Todd and H. Foster Bain, pp. 20-23; pl. I. Preglacial elevation of Iowa, by H. Foster Bain, pp. 23-26. Secular decay of granitic rocks, by Charles Rollin Keyes, pp. 27-31; pll. II-IV. Record of the Grinnell deep boring, by Arthur J. Jones, pp. 31-35. Lansing lead mines, by A. G. Leonard, pp. 36-38. How old is the Mississippi? by Francis M. Fultz, p. 39. Maquoketa shales in Delaware county, by Samuel Calvin, pp. 40-42. Insects, by H. F. Wickham, pp. 45-51. A kymograph and its use, by W. S. Windle, pp. 51-55; pl. V. Changes that occur in ripening corn, by F. C. Curtis, pp. 56 and 57. Chemical analysis of soils, by G. E. Patrick, pp. 58-66. A chemical study of honey, pp. 67-73. Effects of heat on the germination of corn and smut, by F. C. Stewart, pp. 74-78. Plant lice infesting grass roots, by Herbert Osborn and F. A. Sirrine, pp. 78-91; pl. VI. Some bred parasitic hymenoptera in the Iowa Agricultural College collection, by Alice M. Beach, pp. 92-94. A study of the physical properties of solutions of lithium chloride in amyl alcohol, by Launcelot W. Andrews and Carl Ende, pp. 94-103. Distribution of some weeds in the United States, especially *Iva xanthifolia*, *Lactuca scariola*, *Solanum carolinense*, and *Solanum rostratum*, by L. H. Pammel, pp. 103-127. Structure of the seed coats of Polygonaceæ, by Emma Sirrine, pp. 128-136; pll. VII-IX. Lichens collected by Dr. C. C. Parry in Wisconsin and Minnesota in 1848, by Bruce Fink, p. 137. Some glands in the hop-tree, by Cassie M. Bigelow, pp. 138-140; pl. X. Certain minerals of Webster county, Iowa, by Arthur C. Spencer, pp. 143-145; 1 fig. Pollination of cucurbits, by L. H. Pammel and Alice M. Beach, pp. 146-152; pll. XI-XIV. Psyllidæ found at Ames, by C. W. Mally, pp. 152-171; pll. XV-XVII. Cement materials in Iowa, by E. H. Lonsdale, pp. 172-174. Synopsis of American paleozoic echinoids, by Charles Rollin Keyes, pp. 178-194; pll. XVIII-XX. Upper Carboniferous of southwestern Iowa, by E. H. Lonsdale, pp. 197-200. Diseases of plants at Ames, 1894, by L. H. Pammel, pp. 201-208. Extension of the Illinois lobe of the great ice sheet into Iowa, by Francis M. Fultz, pp. 209-212. Glacial markings in southeastern Iowa, by Francis M. Fultz, pp. 213-217; pll. XXI and XXII; fig. 2. Opinions concerning the age of the Sioux quartzite, by Charles Rollin Keyes, pp. 218-222.

Vol. III, 1895, 230 pp.; 15 pll.; 13 figs. Contains the following papers, or abstracts of them: Needed changes in scientific methods, by H. W. Norris, pp. 17-28. Homologies of the cyclostome ear, by H. W. Norris, pp. 29-31. Origin and significance of sex, by C. C. Nutting, pp. 32-36. The reduction of sulphuric acid by copper as a function of the temperature, by Launcelot W. Andrews, pp. 37-40; 1 fig. Clays in the Indianola brick, tile and pottery works, by L. A. Youtz, pp. 40-44. A mad-stone, by T. Proctor Hall and Earnest E. Frisk, pp. 45-47. Physical theories of gravitation, by T. Proctor Hall, pp. 47-52. The Le Claire limestone, by Samuel Calvin, pp. 52-58; pll. I and II; fig. 2. The Buchanan gravels: an inter-

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glacial deposit in Buchanan county, Iowa, by Samuel Calvin, pp. 58-60; pll. III, IV. Recent discoveries of glacial scorings in southeastern Iowa, by Francis M. Fultz, pp. 60-62. Recent developments in the Dubuque lead and zinc mines, by A. G. Leonard, pp. 64-66. The area of slate near Nashua, N. H., by J. L. Tilton, pp. 66-71; pl. V; fig. 3. Notes on the geology of the Boston basin, by J. L. Tilton, pp. 72-74; 1 map. Two remarkable cephalopods from the Upper Paleozoic, by Charles R. Keyes, pp. 76-78; fig. 4. Variation in the position of the nodes on the axial segments of pygidium of a species of *Encrinurus*, by William Harmon Norton, pp. 79-82. A theory of the loess, by B. Shimek, pp. 82-89. Perfect flowers of *Salix amygdaloides* Ands., by B. Shimek, pp. 89-90; fig. 5. Notes on forest distribution in Iowa, by T. H. Macbride, pp. 96-101. The nomenclature question among the slime moulds, by T. H. Macbride, pp. 101-106. Notes on the flora of western Iowa, by L. H. Pammel, pp. 106-135. Some notes on chromogenic bacteria, by L. H. Pammel and Robert Combs, pp. 135-140. Fungous diseases of plants at Ames, Iowa, 1895, by L. H. Pammel and Geo. W. Carver, pp. 140-148. Some anatomical studies of the leaves of Sporobulus and Panicum, by Emma Sirrine and Emma Pammel, pp. 148-159; pl. VI. A comparative study of the spores of North American ferns, by C. B. Weaver, pp. 159-161; pl. VII. Inoculation experiments with *Gymnosporangium macropus* Lk., by F. C. Stewart and G. W. Carver, pp. 162-169. Preliminary notes on the Iowa entomostraca, by L. S. Ross, pp. 170-173. The anatomy of Sphaerium sulcatum Lam., by Gilman A. Drew, pp. 173-181; pll. VIII, IX, X. A study of the genus *Clastoptera*, by Elmer D. Ball, pp. 182-193; pll. XI-XIV. Observations on the Cicadidæ of Iowa, by Herbert Osborn, pp. 194-203. Biologic notes on certain Iowa insects, by Herbert Osborn and C. W. Mally, pp. 203-213; figs. 7-13. Contributions to a knowledge of the Thripidæ of Iowa, by Alice M. Beach, pp. 214-228.

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Vol. IV, 19 x 27 cm., bound in green cloth. Annual report for 1894.

Vol. V. Annual report for 1895, 452 pp.; 14 pll.; 7 maps (colored); 72 figs. Report of state geologist, Samuel Calvin, pp. 1-31. Geology of Jones county, by Samuel Calvin, pp. 35-112; 2 pll.; 8 figs.; 1 colored map. Geology of Washington county, by H. Foster Bain, pp. 115-173; 1 pl.; 1 colored map; 7 figs. Geology of Boone county, by Samuel Walker Beyer, pp. 177-239; 16 figs.; 2 colored maps. Geology of Woodbury county, by H. Foster Bain, pp. 243-299; 1 pl.; 2 colored maps; 12 figs. Geology of Warren county, by J. T. Tilton, pp. 303-359; 4 pll.; 1 colored map; 8 figs. Geology of Appanoose county, by H. Foster Bain, pp. 363-438; 3 pll.; 1 colored map; 20 figs.

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State Historical Society:

Documentary material relating to the history of Iowa, No. 1, edited by Benjamin F. Shambaugh, 24 pp.

No. 2, pp. 25-44.

No. 5, pp. 101-132.

No. 6, pp. 133-184.

Iowa Historical Lectures, delivered before the State Historical Society, Iowa City, 1892, 92 pp.

Iowa Historical Record, quarterly, Vol. V, Nos. 1, 2, and 3, 1889, pp. 193-336; steel engravings of James Lee, Gov. Buren R. Sherman, and George Washington.

Vol. XI, Nos. 1-4, 1895, pp. 193-384; steel engravings of Thomas S. Wilson, Amos Dean, Lyman Parsons, Rev. W. Avery Richards, Charles Aldrich, Silas Totten, and Geo. R. Carroll.

Vol. XII, Nos. 1-3, 1896, pp. 385-528; steel and other engravings of Hon. Joseph Williams, George Grover Wright, Francis Springer, and Samuel Storrs Howe.

SAC CITY, IOWA.—*Fred. R. Stearns & Co., Publishers:*

The American Magazine of Natural Science, a monthly devoted to the study of nature, Vol. II, No. 7, Sample copy, pp. 78-90+vi.

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ATCHISON.—*R. B. Knerr, Ph. D.:*

The Midland, June, 1895, contains: The double tree, by W. B. Werthner, 2 pp.; 1 pl.

The Midland, June, 1896, contains: The Midland dog's-tooth violet, by E. B. Knerr, 5 pp.; 1 colored plate; 2 figs.

EFFINGHAM.—*Atchison County High School:*

High School Quarterly, Vol. II, No. 1, 14 pp.

LAWRENCE.—*George I. Adams, Ph. D.:*

Extinct Felidæ of North America, pp. 419-444; 3 pll. From American Journal of Science, Vol. I, June, 1896.

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E. H. S. Bailey, Ph. D., Kansas State University:

Natural gas and coal oil in Kansas, by E. H. S. Bailey, 14 pp. From Kan. Univ. Quar., Vol. IV., No. 1, 1895.

Arnold Emch, State University:

Projective groups of perspective collineations in the plane treated synthetically, by Arnold Emch, 35 pp.; 13 figs.

Ephraim Miller, Ph. D., Kansas State University:

Outline of mathematical work, by E. Miller, 12 pp.

A new theory of the surface markings of the moon, by E. Miller, 6 pp. From Popular Astronomy.

Astronomy in the high schools, by E. Miller, 4 pp. From Popular Astronomy.

University of Kansas:

Catalogue of the University for the year 1895-'96, 146 pp.; 1 half-tone plate.

Catalogue of the School of Law for collegiate year 1895-'96, 20 pp.; 1 half-tone plate.

Catalogue of the School of Pharmacy for the collegiate year 1895-'96, 33 pp.; 4 half-tone plates.

Bulletin of the University Extension lecture courses for academic year 1896-'97, May, 1896, 33 pp.

Bulletin of the Department of Mathematics and Astronomy, 1896-'97, May, 1896, 7 pp.

University of Kansas Geological Survey, Erasmus Haworth, Geologist:

The University Geological Survey of Kansas, Vol. I, 19x25 cm., 330 pp.; 31 pll.; 9 figs. Geologic section from Galena to Wellington, by George I. Adams, pp. 16-30; 1 pl. Geologic section across the Flint hills along the Missouri Pacific railroad, beginning at Cedarvale and extending to Winfield, by C. N. Gould, pp. 31-34; 1 fig. Geologic section from Baxter Springs to the Nebraska line, by Erasmus Haworth and John Bennett, pp. 35-71; 1 pl.; 2 figs. Geologic section along the Neosho and Cottonwood rivers, by M. Z. Kirk, pp. 72-85; 1 pl. Geologic section along the Missouri Pacific railroad from the state line, Bourbon county, to Yates Center, by John Bennett, pp. 86-98; 1 pl.; 1 fig. Geologic section from state line, opposite Boicourt, to Alma, principally along the Osage river, by John G. Hall, pp. 99-106; 1 pl. Geologic section along the Kansas river from Kansas City to McFarland, including a section along Mill creek, by John Bennett, pp. 107-124; with an addendum, by Geo. I. Adams, pp. 124-128; 1 fig.; 1 pl. Geologic section from Coffeyville to Lawrence, by Erasmus Haworth, pp. 129-139; 1 pl. Geologic section from Atchison to Barnes, along the Central branch of the Missouri Pacific railroad, by E. B. Knerr, pp. 140-144; 1 pl. Resume of the stratigraphy and correlations of the carboniferous formations, by Erasmus Haworth, pp. 195-217; 8 pll.; 3 figs. The coal fields of Kansas (preliminary), by Erasmus Haworth, pp. 218-251. Oil and gas in Kansas (preliminary), by Erasmus Haworth, pp. 232-245. Surface gravels of the Carboniferous area, by Erasmus Haworth, pp. 246-255. The coal-measure soils (preliminary), by Erasmus Haworth, pp. 256-269. Preliminary catalogue of the invertebrate paleontology of the Carboniferous of Kansas, by John Bennett, pp. 270-310.

The Kansas University Quarterly, Vol. III, Nos. 3 and 4, pp. 165-310 + xiv; pll. XIV-XXI; 1 map; several figures. New or little-known extinct vertebrates, by S. W. Williston, pp. 165-176; pll. XIV-XIX. Cnephalia and its allies, by W. A. Snow, pp. 177-186. A new species of *Pelecocera*, by W. A. Snow, p. 187. Exotic Tabanidæ, by S. W. Williston, pp. 189-196. Chemical analysis of counterfeit gold dust, by V. L. Leighton and H. P. Cady, pp. 197-200. The temperature sense, by William Newton Logan, pp. 201-204. American Platypezidæ, by W. A. Snow, pp. 205-207. Semi-arid Kansas, by S. W. Williston, pp. 209-216; with map of Kansas. Collection and storage of water in Kansas, by E. C. Murphy, pp. 218-224; with map of Kansas. Diptera of Colorado and New Mexico, by W. A. Snow, pp. 225-248. Supplementary list of North American Syrphidæ, by W. A. Snow, pp. 249-262. *Dialysis* and *Triptotricha*, by S. W. Williston, pp. 263-266; fig. 1. New Bombyliidæ, by S. W. Williston, pp. 267-269. The stratigraphy of the Kansas coal measures, by Erasmus Haworth, pp. 271-290; figs. 1 and 2. Division of the Kansas coal measures, by Erasmus Haworth, pp. 291-296; figs. 3 and 4. The coal fields of Kansas, by Erasmus Haworth, pp. 297-310; pll. XX and XXI.

Vol. IV, Nos. 1-4, 260 pp.; 4 pll.; 35 figs. Natural gas and coal oil in Kansas, by E. H. S. Bailey, pp. 1-14. Experiments in the solution of the labor problem, by F. W. Blackmar, pp. 15-30. The servant-girl problem, by Martha Boutelle Snow, pp. 31-40. The condition of packing-house employees, by A. E. Moody, pp. 41-60. Note on the mandible of *Ornithostoma*, by S. W. Williston, p. 61; pl. I. Notes on air resistance and pressure, by E. C. Murphy, pp. 63-66; pl. II. The Coffeyville explosion, by Erasmus Haworth, pp. 67-70. Projective transformations, by H. B. Newson, pp. 71-92; figs. 1-5. Theoretical and measured pumping power of windmills, by E. C. Murphy, pp. 93-106; figs. 1-11. Two remarkable new genera of diptera, by S. W. Williston, pp. 107-110. Involutoric transformation of the

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MANHATTAN.—*Kansas State Agricultural College:*

Annual report for 1895.

Tenth Biennial Report of Board of Regents and faculty, 1895-'96, 98 pp.; 10 half-tone plates.

Bulletins: No. 49, May, 1895. Cattle poisoning by potassium nitrate — mastitis, 18 pp.

No. 50, June, 1895. Kansas Weeds, I — seedlings, 54 pp.; 9 pll., including drawings of 145 species of Kansas weed seedlings.

No. 51. Steer Feeding, IV — a comparison between pure-bred shorthorns and scrubs.

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No. 54. Experiments with oats.

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No. 56. Experiments with Corn and Kaffir corn.

No. 57, June, 1896. Kansas weeds, III — a descriptive list, with distribution, 64 pp., including 27 pp. of plates, showing drawings of 209 species of common Kansas weeds, by Miss Bertha Kimball and Mr. Geo. L. Clothier, and as many diminutive maps of Kansas, each showing the distribution through the state of one weed, by Prof. A. S. Hitchcock.

No. 58, June, 1896. Cornstalk disease of cattle — preliminary bulletin, pp. 65-78.

No. 59, August, 1896. Experiments with wheat, pp. 89-105.

No. 60, September, 1896. Steer-feeding Experiments, series V, pp. 107-146.

No. 61, November, 1896. Kaffir corn, corn, and soy-bean meal for feed for pigs and cattle, pp. 147-168.

No. 62. Corn Smut, by A. S. Hitchcock and J. B. S. Norton, pp. 169-212; 10 pll.

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Grasses of Kansas. From Transactions of the Kansas Academy of Science, 1893-'94, pp. 135-149; 2 pll.

Lora L. Waters, Author:

Erysipheæ of Kansas. From Transactions of the Kansas Academy of Science, 1893-'94, 5 pp.; 2 pll.

ROCKPORT.—*Elam Bartholomew, Author:*

New Kansas Fungi, by J. B. Ellis and Elam Bartholomew. From Erythea, pp. 1-4, 23-29, 79-83.

TOPEKA.—*Adjutant General of the State of Kansas:*

Tenth Biennial Report, 1895-'96, bound in blue cloth, S. M. Fox, Adjutant General, 104 pp.

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Tenth Biennial Report, Vol. XV, 1895-'96, bound in cloth, F. D. Coburn, Secretary, 855 pp.

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Kansas Exhibit at the World's Fair, 1893, 21 pp.

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Geology and Mineral Resources of Kansas, by Robert Hay, 66 pp., with map of the state and several plates and figures.

World's Fair report, 1893, 60 pp.

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Report of the Commissioner of Forestry for the two years ending June 30, 1894, by E. W. Wheeler, Commissioner, 32 pp.

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Annual Report for 1894, 399 pp., with map of Kansas.

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Tenth Biennial Report, 1895-'96, by W. C. Edwards, Secretary of State, 116 pp.

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Tenth Biennial Report of Auditor of State, 1895-'96, by George E. Cole, Auditor of State, 358 pp.

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Fourth Biennial Report, bound, 1894, by William H. Barnes, Secretary, 100 pp.

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Seventh Annual Report, for the year ending December 31, 1894, 71 pp.

Eighth Annual Report, Bennett Brown, inspector, 1895, 213 pp. Geological map of Kansas.

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8. Report on climatology of cotton plant, by P. H. Mell, 68 pp.; 7 charts.

9. Report on the forecasting of thunder-storms during the summer months of 1892, 54 pp.; 4 charts.

John MacDonald, Editor:

Western School Journal, 20 x 25 cm. Vol. XXII, 1895, 278 pp.; ill. Vol. XXIII, 1896, 270 pp.; ill.

Henry W. Roby, Author:

Medicine and surgery in the twentieth century, from the Homeopathic Physician for July, 1896, 7 pp.

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Harmonic Forms, from Transactions of the Kansas Academy of Science, 1893-'94, 72 pp.; 78 figs.

Terminal Boulder Belt in Shawnee county, from Transactions of the Kansas Academy of Science, 1893-'94, 7 pp.; 1 map.

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Supplement to the Portland Catalogue of Maine Plants, by Merritt L. Fernald. From Proceedings, 1895, pp. 73-96.

Edward L. Rand, Author:

Preliminary Catalogue of the plants growing on Mount Desert and adjacent islands, bound in linen, by Edward L. Rand and John H. Redfield, 286 pp.; 1 map.

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BALTIMORE.—*Johns Hopkins University:*

Circulars 108-127. Vol. XIII. The herbarium and library of Capt. John Donnell Smith, by John P. Lotsy, pp. 22-25. Sixth annual excursion of geological department, 1893, by George H. Williams, pp. 26-27. Morphological notes from biological laboratory, by William K. Brooks, pp. 57-64. Notes from the astronomical department, pp. 65-69. Notes from the physical laboratory, edited by Joseph S. Ames, pp. 73-80. Notes from the geological laboratory, edited by George H. Williams, pp. 81-86.

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BOSTON.—*American Academy of Arts and Sciences:*

Proceedings, New Series, Vol. XXX, May, 1894, to May, 1895, 626 pp.; 6 pll.; about 16 figs. On the determination of sulphur in volatile organic compounds, by Charles F. Mabery, pp. 1-8. Double haloid salts of antimony, calcium, and magnesium, by Francis Gano Benedict, pp. 9-16. North American *Ceuthophili*, by Samuel H. Scudder, pp. 17-113. Mexican plants, by B. L. Robinson and M. L. Fernald, pp. 114-123. Nitroparaffine salts, by J. U. Nef, pp. 124-148. Bivalent carbon, second paper, by J. U. Nef, pp. 151-193. Batteries in multiple arc, by B. O. Peirce, pp. 194-199. Cell lineage of the ascidian egg, by W. E. Castle, pp. 200-217; pll. I and II. Wave lengths of electricity, by Charles E. St. John, pp. 218-246; figs. 1-9. Heat method for measuring the coefficient of self-induction, by P. G. Spalding and H. B. Shaw, pp. 247-250; figs. 1 and 2. Complex inorganic acids, by Wolcott Gibbs, pp. 251-282. Blastodermic vesicle of *Sus scrofa*, by A. W. Weysse, pp. 283-322; pll. I-IV. Ternary mixtures, by Wilder D. Bancroft, pp. 324-368. Atomic weight of strontium, by Theodore William Richards, pp. 369-389; 2 figs. Electrical resistances of certain poor conductors, by B. O. Peirce, pp. 390-395; figs. 1-4. *Uredo polypodii*, with plate, by B. M. Duggar, pp. 396-400. Trinitrophenylmalonic ester, by C. Loring Jackson and C. A. Soch, pp. 401-408. Acetals from quinones, by C. Loring Jackson and H. S. Grindley, pp. 409-457. Cupriammonium salts, second paper, by Theodore William Richards and Andrew Henderson Whitridge, pp. 458-466. Notes on Laboulbeniaceæ, by Roland Thaxter, pp. 467-481. Experiments and observations on the summer ventilation and cooling of hospitals, by

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Morrill Wyman, pp. 482-489. Experiments on the relation of hysteresis to temperature, by Frank A. Laws and Henry E. Warren, pp. 490-502; figs. 1-6.

Vol. XXXI, May, 1895, to May, 1896, 408 pp.; 1 pl.; 13 figs. On the composition of the Ohio and the Canadian sulphur petroleums, by Charles F. Mabery, pp. 1-66. On the occlusion of baric chloride by baric sulphate, by G. W. Richards and H. G. Parker, pp. 67-77. Cupri-ammonium double salts, third paper, by T. W. Richards and George Oenslager, pp. 78-86. On the cuprianiline acetobromides, by T. W. Richards and Frederick Charles Moneton, pp. 87-95. The chemical potentials of the metals, by Wilder D. Bancroft, pp. 96-122. On the behavior of certain derivatives of benzol containing halogens, by C. Loring Jackson and Sidney Calvert, pp. 123-135. Bromine derivatives of metaphenyline diamine, by C. Loring Jackson and Sidney Calvert, pp. 136-157. A revision of atomic weight of zinc. I. Analysis of zincic bromide, by T. W. Richards and E. T. Rogers, pp. 159-180. Note on the automorphic linear transformation of a bilinear form, by Henry Taber, pp. 181-192. Thermo-electric interpolation formulæ, by S. W. Holman, pp. 193-217; 1 fig. Melting points of aluminum, silver, gold, copper, and platinum, by S. W. Holman, with R. R. Lawrence and L. Barr, pp. 218-233; 5 figs. Calibration of Le Chatelier thermo-eclectric pyrometer, by S. W. Holman, pp. 234-244; 2 figs. Methods of cooling correction, by S. W. Holman, pp. 245-254; 2 figs. On some points in the development of æcidia, by H. M. Richards, pp. 255-270; 1 pl. On the thermal conductivity of mild steel, by Edwin H. Hall, pp. 271-302; 13 figs. The outline of Cape Cod, by Wm. M. Davis, pp. 303-332; 6 figs. Preliminary notes on the embryology of the star-fish (*Asterias pallida*), by Seitaro Goto, pp. 333-335. The group of real linear transformations whose invariant is an alternate bilinear form, by Henry Taber, pp. 336-337.

Vol. XXXII, No. 1. The following articles, by B. L. Robinson and J. M. Greenman, pp. 1-51: Revision of the genus *Tridax*. Synopsis of the Mexican and Central American species of the genus Calea. A provisional key to the species of *Porophyllum* ranging north of the Isthmus of Panama. Descriptions of new and little-known phanerogams chiefly from Oaxaca. No. 2. A revision of the Atomic Weight of Magnesium, by T. W. Richards and H. G. Parker, pp. 55-73; 3 figs.

Boston Society of Natural History:

Proceedings, Vol. XXI, Part III, October, 1881, to January, 1882. Some points relating to the geological exploration of the fortieth parallel, by M. E. Wadsworth, pp. 243-274. On the relation of the Quincy granite to the primordial argillite of Braintree, Mass., by M. E. Wadsworth, pp. 274-277. On the classification of the textures and structures of rocks, by W. O. Crosby, pp. 279-288. On the trachyte of Marblehead Neck, Mass., by M. E. Wadsworth, pp. 288-294. Temperature of trees, by D. P. Penhallow, 294-298; 1 pl. On the claws and spurs on birds' wings, by J. Amory Jeffries, pp. 301-306. On some differences in mouth structure of tadpoles of the anourous batrachians found in Milton, Mass., by Mary H. Hinckley, pp. 307-314. On the classification of lake basins, by W. M. Davis, pp. 315-352.

Vol. XXVI, Part IV, November, 1894, to May, 1895; pp. 393-562; pl. v; 2 maps; 9 figs. Descriptions of certain lepidopterous larvæ, by Harrison G. Dyar, pp. 394-403: figs. 1-4. Geographical distribution of the eastern races of the cotton-tail (*Lepus sylvaticus* Bach.), by Outram Bangs, pp. 404-414. The origin of the Arkansas novaculites, by L. S. Griswold, pp. 414-421. The Tusayan new fire ceremony, by Dr. J. Walter Fewkes, pp. 422-458. Introitus vaginæ of certain Muridæ, by Gerrit S. Miller, jr., pp. 459-468; pl. v. Karyokinesis and the fertilization of the ovum, by Prof. Edmund B. Wilson, pp. 469-473. Origin of the lower Mississippi, by L. S. Griswold, pp. 477-479; 1 map. Geographic development of Crowley's Ridge, by C. F. Marbut, pp. 479-488; figs. 1-3. Remarks on the cuspate capes of the Carolina coast, by Cleveland Abbe, jr., pp. 489-497; figs. 1 and 2. Southwestern part of the Boston basin, by J. L. Tilton, pp. 500-505; 1 map. Notes on North American mammals, by Outram Bangs, pp. 529-546. Cerro Viejo and its volcanic cones, by J. Crawford, pp. 546-557.

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clature, by Samuel H. Scudder, pp. 201-218. Thomas Tracy Bouve. Memorial meeting of the Boston Society of Natural History, December 2, 1896, pp. 219-241.

Massachusetts State Board of Agriculture:

Bulletin, Vol. —, No. 4, March, 1896. 1. Tuberculin — what it is; how it is used; what it does, by Prof. James B. Paige, pp. 341-346. 2. Birds as protectors of orchards, by E. H. Forbush, pp. 347-362. Insecticides, by A. H. Kirkland, pp. 363-371; 2 figs. 4. Hints on land drainage, by Wm. Wheeler, pp. 372-384. The San Jose scale, by Prof. C. H. Fernald, pp. 385-394; 5 figs.

Report on the Gypsy Moth, *Porthetria dispar* (Linn.), 1896, by Edward H. Forbush and Charles H. Fernald, pp. xii + 496; 66 pll. (4 colored); 5 maps; 37 figs. Appendices, pp. i-c.

Massachusetts Horticultural Society, Robert Manning, Secretary:

Transactions of the Massachusetts Horticultural Society for the year 1894, Part II, pp. 205-444, Reports.

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Psyche, a Journal of Entomology, Vol. VII, Nos. 224-248, pp. 169-468; 45 figs. Convergence and poecilogony among insects, by Alfred Giard, Paris, France, pp. 171-175. Preparatory stages of *Sphinx vashti* Strecker, by Harrison G. Dyar, p. 177. Check-list of African Coccidæ, by T. D. A. Cockerell, p. 178. On the Rhopalomeridæ, by S. W. Williston, pp. 183-187. Life-history of *Clisiocampa fragilis* Stretch, by H. G. Dyar, pp. 189-191. Two new species of *Entomobrya*, by F. L. Harvey, pp. 196-199; figs. 1-3. The Tipulid genera *Bittacomorpha* and *Pedicia*, by J. M. Aldrich, pp. 200-202; 1 fig. New North American Odonata, by Albert P. Morse, pp. 207-211, 274, 275. Description of some of the larval stages of *Amphion nessus*, by Caroline G. Soule, pp. 212-213. A comparison of *Colias hecla* with *Colias meadii* and *Colias elis*, by Thomas E. Bean, pp. 219-229. On a rational nomenclature of the veins of insects, especially those of Lepidoptera, by A. S. Packard, pp. 235-241; 8 figs. Notes on the winter insect fauna of Vigo county, Indiana, by W. S. Blatchley, pp. 247-250, 267-270, 279-281, 336-340, 379-381, 399-401, 434-437, 455-458. Eggs of the ox-louse, *Hæmatopinus vitula* L., by F. L. Harvey, pp. 250 and 251; 1 fig. Life-history of *Clisiocampa pluvialis* Dyar, by H. G. Dyar, pp. 259-260; 2 figs. Woolly leaf-gall made by a species of *Callirhytis* on scrub oak, by C. H. Tyler Townsend, pp. 262 and 263. New North American Odonata, by Albert P. Morse. Some habits of *Formica obscuripes* Forel, by George B. King, pp. 281-283. Revision of the species of *Spharagemon*, by Albert P. Morse, pp. 287-299; 14 figs. Notes on the habits of *Trypoxylon rubrocinctum* and *T. albopilosum*, by George W. Peckham and Elizabeth G. Peckham, Milwaukee, Wis., pp. 303-306. The Ephemeridæ and venation nomenclature, by Vernon L. Kellogg, pp. 311-315; figs. 1-4. Notes on the Acrididæ of New England, by Albert P. Morse, pp. 323-327, 342-344, 382-384, 402-403, 407-411, 419-422, 443-445; pl. VII. Species of *Exorista* of temperate North America, by C. H. Tyler Townsend, pp. 329-331. New species of *Papirius*, by Justus Watson Folsom, pp. 344-345. The hibernation of aphides, by Clarence M. Weed, pp. 351-362; 1 fig. Coleoptera found with ants, by H. F. Wickham. Third paper, pp. 370-372. The Mallophaga, by Vernon L. Kellogg, pp. 375-379. *Neelus murinus*, representing a new Thysanuran family, by Justus Watson Folsom, pp. 391-392; pl. VIII. A new structural character in insects, by R. A. Cooley, pp. 395-398; pl. IX. The condition of *Apatela*, by A. Radcliffe Grote, pp. 411-414. Preparatory stages of *Cosmosoma auge* Linn., by H. G. Dyar, pp. 414-416. A Thysanuran of the genus *Anoura*, by F. L. Harvey, pp. 422-423; 3 figs. Life-history of *Ichthyura strigosa* Grote, by Harrison G. Dyar, pp. 424-425. The species of *Nemobius* found in North America, by Samuel H. Scudder, pp. 431-434. Some additional species of Prosapis, by T.

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D. A. Cockerell, pp. 437-439. New Smynthuri, including myrmecophylous and aquatic species, by J. W. Folsom, pp. 446-450; 1 pl. Partial life-history of *Halisidota cinctipes* Grote, by Harrison G. Dyar, pp. 450-451. Life-history of *Dellephila lineata*, by Caroline G. Soule, pp. 458-460. Supplement I. New North American Coccidæ, bees, and other insects, by T. D. A. Cockerell, pp. 1-11, 15-32. New homoptera received from the New Mexico Agricultural Experiment Station, by Carl F. Baker, pp. 12-14; figs. 1-4. Supplement II. List of Mount Washington Coleoptera, by F. C. Bowditch, pp. 1-11.

Museum of Comparative Zoology at Harvard College:

Annual report of the curator, for 1894-'95, 58 pp.

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Vol. XXV, No. 12. Reports on the dredging operations off the west coast of Central America to the Galapagos, to the west coast of Mexico, and in the Gulf of California, in charge of Alexander Agassiz. Art. XVI, die Pelagischen Copepoden, von Wilhelm Giesbrecht, pp. 221-264; 4 pll.

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Vol. XXVII, No. 1. Spermatogenesis of *Caloptenus femur-rubrum* and *Cicada tibicen*, by E. V. Wilcox, 32 pp.; 5 pll.; 12 figs.

No. 2. On the early development of *Limax*, by C. A. Kofoid, pp. 33-118; 8 pll.; 5 figs.

No. 3. Birds from Cocos and Malpelo islands, with notes on petrels obtained at sea, by C. H. Townsend, pp. 119-126; 2 colored pll.

No. 4. Die Comatuliden, von C. Hartlaub, pp. 127-152; 4 pll.

No. 5. Die Ostracoden, von G. W. Muller, pp. 153-170; 3 pll.

No. 6. A preliminary catalogue of the processes concerned in ontogeny, by C. B. Davenport, pp. 171-200; 31 figs.

No. 7. The early embryology of *Ciona intestinalis* Fleming (L.), by W. E. Castle, pp. 201-280; 13 pll.

Vol. XXVIII, No. 1. Fossil Sponges of the flint nodules in the lower cretaceous of Texas, by J. A. Merrill, pp. 1-26; 1 pl.

2. The Elevated Reef of Florida, by Alexander Agassiz, with notes on the geology of southern Florida, by Leon S. Griswold, pp. 29-62; 26 pll.

3. Notes on the Artesian Well sunk at Key West, Fla., in 1895, by E. O. Hovey, pp. 65-91.

Vol. XXIX, No. 1. The Foraminifera, by Axel Goes, pp. 1-104; 9 pll.

No. 2. The Reactions of Metridium to food and other substances, by G. H. Parker, pp. 105-120.

No. 3. The Anatomy and Histology of *Caudina arenata* Gould, by John Hiram Gerould, pp. 123-190; 8 pll.

No. 4. Further Studies on the Spermatogenesis of *Caloptenus femur-rubrum*, by E. V. Wilcox, pp. 191-206; 3 pll.

No. 5. The Development of the Wing Scales and their pigments in butterflies and moths, by Alfred Goldsborough Mayer, pp. 207-236; 7 pll.

No. 6. Report on the Turbellaria collected by the Michigan State Fish Commission during the summers of 1893 and 1894, by W. McM. Woodworth, pp. 237-244; 1 pl.

Vol. XXX, No. 1. The Early Development of *Asplanchna herrickii* De Guerne, by Henry S. Jennings, pp. 1-116; 10 pll.

No. 2. Some variations in the genus *Eucope*, by Alexander Agassiz and W. McM. Woodworth, pp. 121-150; 9 pll.

No. 3. Supplementary Notes on the Crustacea, by Walter Faxon, pp. 153-166.

SALEM.—*Essex Institute:*

Vol. XXVII. Bulletins, 1-6. Annual meeting, May 21, 1895, 52 pp.

Vol. XXVI, Nos. 7-12. On the so-called Bow-pullers of Antiquity, by Edward S. Morse, pp. 141-166; 5 pll.; 12 figs. Geological and mineralogical notes, by John H. Sears, pp. 179-201; 5 pll.

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TUFTS COLLEGE.— *Tufts College Library:*

Tufts College Studies, No. IV. The Morphology and Classification of the Pauropoda, with notes on the Morphology of the Diplopoda, by Frederick C. Kenyon, pp. 77-148; pll. I-IV.

MICHIGAN.

AGRICULTURAL COLLEGE.— *Michigan Agricultural College:*

Catalogue for 1896.

DETROIT.— *Frederick Stearns:*

List of Duplicates of marine, land and fresh-water shells from Japan, Loo Choo Islands, Bahamas, Hawaiian Islands, Philippine Islands, Polynesian Islands, etc. Collected by Frederick Stearns, 20 pp.

MINNESOTA.

MINNEAPOLIS.— *Geological and Natural History Survey of Minnesota, N. H. Winchell, State Geologist:*

Second Annual Report, for the year 1873. Second edition, by N. H. Winchell, State Geologist, pp. 75-519, paging of Regents' Report, of which it was originally a part; numerous figures.

Third Annual Report, for the year 1874. Second edition, by N. H. Winchell, State Geologist, pp. 145-186, paging of original Regents' Report.

Sixth Annual Report, for the year 1877, by N. H. Winchell, State Geologist, 225 pp.; maps and plates. Contains the Geology of Morrison, Ramsey, Rock and Pipestone, and Rice counties, with maps of the counties.

Twenty-second Annual Report, for the year 1893, N. H. Winchell, State Geologist, 210 pp. Contains reports on the field work of Warren Upham, U. S. Grant, J. E. Todd, G. E. Culver, J. E. Spurr, C. P. Berkey, and A. H. Elftman. Upham's work, pp. 18-66, with map of the state, is glacial and physiographic; Grant's work is mineralogical.

Twenty-third Annual Report, for the year 1894, 255 pp. The origin of the Archæan greenstones, by N. H. Winchell, pp. 1-35. Preliminary report on the Rainy Lake gold region, by H. V. Winchell and U. S. Grant, pp. 36-105; 1 map; 4 ill. Topographical survey, by W. R. Hoag, pp. 106-115. Historical sketch of the discovery of mineral deposits in the Lake Superior region, pp. 116-155. Late glacial or Champlain subsidence and re-elevation of the St. Lawrence river basin, by Warren Upham, pp. 156-193; 1 map. Notes on Minnesota minerals, by Charles P. Berkey, pp. 194-202. The progress of mining, by H. V. Winchell, pp. 215-219. Notes upon the bedded and banded structures of the gabbro, and upon an area of troctolite, by Arthur H. Elftman, pp. 224-230.

The Geology of Minnesota, 25 x 32 cm., Vol. III, Part I, of the Final Report. Palæontology, by Leo Lesquereux, Anthony Woodward, Benj. W. Thomas, Charles Schuchert, Edward O. Ulrich, and N. H. Winchell, lxxx + 474 pp.; 1 map; 41 full-page lithographic plates of about 800 figures. Chap. I. Cretaceous fossil plants from Minnesota, by Leo Lesquereux, pp. 1-22; pll. A, B. Chap. II. Microscopical flora and fauna of the Cretaceous in Minnesota, with additions from Nebraska and Illinois, by Anthony Woodward and Benj. W. Thomas, pp. 23-54; pll. C, D, E. Chap. III. Sponges, graptolites, and corals of the Lower Silurian of Minnesota, by N. H. Winchell and C. Schuchert, pp. 55-95; pll. F, G; 7 figs. Chap. IV. On Lower Silurian bryozoa of Minnesota, by E. O. Ulrich, pp. 96-332; pll. I-XXVIII; 73 figs. Chapter V. The Lower Silurian Brachiopoda of Minnesota, by N. H. Winchell and Charles Schuchert, pp. 333-374; pll. XXIX-XXXIV; 14 figs.

Vol. III, Part II, Paleontology, by E. O. Ulrich, John M. Clarke, Wilber H. Scofield, and Newton H. Winchell, pp. lxxxi-cxxviii+475-687; 48 full-page lithographic plates, of nearly 1,000 figures of fossil shells. The Lower Silurian deposits of the upper Mississippi province: A correlation of the strata with those in the Cincinnati, Tennessee, New York, and Canadian provinces, and geographic distribution of the fossils, by N. H. Winchell and E. O. Ulrich, pp. lxxxiii-cxxviii. Chap. VI. The Lower Silurian Lamellibranchiata of Minnesota, by E. O. Ulrich, pp. 475-628; pll. XXXV-XLII. Chap. VII. The Lower Silurian Ostracoda of Minnesota, by E. O. Ulrich, pp. 629-694; pll. XLIII-XLVI. Chap. VIII. The Lower Silurian Trilobites of Minnesota, by John M. Clarke, pp. 696-760; 82 figs. Chap. IX. The Lower Silurian Cephalopoda of Minnesota, by John M. Clarke, pp. 761-812; pll. XLVII-LX; 10 figs. Chap. X. The Lower Silurian Gastropoda of Minnesota, by E. O. Ulrich and W. H. Schofield, pp. 813-1,031; pll. LXI-LXXXII; 12 figs.

University of Minnesota — Agricultural Experiment Station:

Bulletins, No. 37, December, 1894. The Chinch-bug, by Otto Lugger, pp. 153-182.

No. 38, Garden Tillage; 39, Potatoes; 40, Grain and forage crops, December, 1894, pp. 185-292.

No. 41, August, 1895, Soils; 42, December, 1895, Digestibility and food value of Potatoes, pp. 1-96.

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No. 43, January, 1896, Insects injurious in 1895, by Otto Lugger, pp. 97-232; 16 pp. of plates; 72 figs.

No. 44, Fattening steers and lambs in winter; 45, Potatoes, variety tests; 46, Forage, etc., December, 1895, pp. 253-392; several figures.

U. S. Grant, Assistant Geologist:

Preliminary Report on the Rainy Lake Region, by Horace V. Winchell and Ulysses S. Grant. From 23d annual report, pp. 35-105; map of Rainy lake; 3 illustrations.

Otto Lugger, Entomologist of State Experiment Station:

First Annual Report, for the year 1895, by Otto Lugger, Professor of Entomology, University of Minnesota, 156 pp. This report contains the same print, same illustrations, and same errors, as Bulletin No. 43, above, but with a different pagination and on a better quality of paper.

Second Annual Report, for the year 1896, by Otto Lugger, State Entomologist, pp. x + 244; 16 pll.; 187 figs. This is a decidedly instructive and valuable treatise on mites, mange, scab, ticks, lice, fleas, bugs, flies, and other parasites of man and animals. Illustrations, which are numerous, are mostly original.

D. T. MacDougal, Assistant in Botany, State University:

Botanic Gardens, from Popular Science Monthly for December, 1896, 27 pp., and 13 views of gardens, etc.

Conway MacMillan, State Botanist:

Minnesota Botanical Studies, Bulletin No. 9. Part V. Compilation of records of some Minnesota flowering plants, by Edmund P. Sheldon, pp. 223-227. List of fresh-water algæ collected in Minnesota during 1894, by Josephine E. Tilden, pp. 228-238. The grand period of growth in a fruit of *Cucurbita pepo*, determined by weight, by Alex. P. Anderson, pp. 238-279; 20 pll. Preliminary List of the mosses of Minnesota, by John H. Holzinger, pp. 280-294.

Part VI. Contribution to the Bibliography of American Algæ, by Josephine E. Tilden, pp. 295-421.

Part VII. On the genus *Cypripedium* L., with reference to Minnesota species, by Henrietta G. Fox, pp. 423-449; 7 pll. Poisonous influence of various species of *Cypripedium*, by T. D. MacDougal, pp. 450-452. Tree temperatures, recorded by Roy W. Squires, pp. 452-459. Some Hepaticæ of Minnesota, by John W. Holzinger, pp. 460, 461. A study of some Minnesota Mycetozoa, by Edmund P. Sheldon, pp. 462-482; pll. XXI-XXVII, all double page.

Part VIII. On the distribution of the North American Helvellales, by Lucien M. Underwood, pp. 483-500. Physiology of the root tubers of *Isopyrum biternatum* T. & G., pp. 501-516; pll. XXVIII, XXIX. Determinations of plants collected by Dr. J. H. Sandberg in northern Minnesota during 1891, by J. M. Holzinger, pp. 517-574. Some Muscineæ of the northern boundary of Minnesota, collected by Conway MacMillan during 1895, by J. M. Holzinger, pp. 579-582. Notes on the moss flora of Minnesota, by J. M. Holzinger, pp. 590-596. List of fresh-water algæ collected in Minnesota during 1895, by Josephine E. Tilden, pp. 597-600.

Henry F. Nachtrieb, State Zoologist:

Second Report of the State Zoologist. Synopsis of the Entomostraca of Minnesota, St. Paul, 1895, 350 pp.; 81 pp. of plates. Part I. Copepoda of Minnesota, by C. L. Herrick, pp. 39-108; pll. I-XXXII. Part II. Cladocera of Minnesota, by C. L. Herrick, with notes by C. H. Turner, pp. 139-276; pll. XXXIII-LXIV. Fresh-water Ostracoda of the United States, by C. H. Turner, pp. 277-337; pll. LXV-LXXXI.

ST. PAUL.—*St. Paul Public Library:*

Thirteenth Annual Report, for the year ending December 31, 1894, 15 pp.

MISSOURI.

COLUMBIA.—*Missouri Agricultural College Experiment Station:*

Bulletin No. 28. Feeding Tests, January, 1895, 39 pp.; 6 pll.

29. Feeding wheat to pigs, April, 1895, 20 pp.; chart.

31. Spraying orchards and vineyards, July, 1895, 21 pp.

32. Field experiments with corn, October, 1895, 32 pp.

33. Potato growing, January, 1896, 24 pp. Winter course in Agriculture, 1895-'96, 10 pp.

36. The Lesser Apple-leaf folder; The Leaf crumpler, pp. 62-80; 6 illustrations.

JEFFERSON CITY.—*Geological Survey of Missouri, Chas. R. Keyes, State Geologist:*

Folio sheet reports: The Bevier sheet, 2 pp.; 1 map; 1 section chart.

Iron Mountain sheet, 2 pp.; 1 map; 1 pl. of sections.

Mine La Motte sheet, 2 pp.; 2 maps.

Vols. VI and VII, bound separately, xxi+xxi+763 pp.; 41 pll.; 268 figs. By Arthur Wins-

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low. Part I. Lead and Zinc, history, compounds, modes of occurrence, distribution, etc., pp. 1-266. Part II. Lead and Zinc in Missouri, a report on the history of mining in the state, on the geology of the mining districts, etc., pp. 267-542. (Vol. VI ends on p. 387.) Part III. Missouri Lead and Zinc mines, a systematic and detailed description of the important developments and occurrences of Lead and Zinc ores, pp. 543-724. Appendices: A. A Study of the Cherts of Missouri. B. Methods of Analysis. C. List of References, pp. 725-753.

Vol. VIII, Annual Report, 405 pp.; 30 pll.; 15 figs.; map of the crystalline rocks, 35x35 cm. The crystalline rocks of Missouri, by Erasmus Haworth, pp. 30-222; 30 pll.; 15 figs. Dictionary of Altitudes of Missouri, by Curtis F. Marbut, pp. 227-316. Characteristics of the Ozark Mountains, by Chas. R. Keyes, pp. 319-352. Coal Measures of Missouri, by Garland C. Broadhead, pp. 355-395.

Vol. IX. Areal Geology, for sheets 1-4, 116+85+96+132 pp.; 25 pll.; 53 figs. Areal Geology of Missouri, by Chas. R. Keyes, pp. 11-16. Report on the Higginsville sheet, by Arthur Winslow, pp. 1-99; 3 pll.; 7 figs. Report on the Bevier sheet, by C. H. Gordon, assisted by J. E. Todd and H. A. Wheeler, pp. 1-75; 5 figs. Report on the Iron Mountain sheet, by Arthur Winslow, Erasmus Haworth, and Frank L. Nelson, pp. 1-85; 5 pll.; 14 figs. Report on Mine La Motte sheet, by Chas. R. Keyes, pp. 1-132; 14 pll.; 27 figs.

SEDALIA.—*F. A. Sampson:*

Bulletin of the Missouri Mining Club, Vol. I, No. 1, January, 1895, 67 pp.; 1 pl.

Topographical Survey in Southeast Missouri. Report made by the commissioners and chief engineer, 1895, 19 pp.

ST. LOUIS.—*Academy of Science of St. Louis:*

Transactions. Vol. VII. No. 1. A Study of the Unionidæ of Arkansas, with incidental reference to their distribution in the Mississippi valley, by R. Ellsworth Call, pp. 1-65; 21 pll.

No. 2. On the Electrical Capacity of bodies and the energy of an electrical charge, by Francis E. Nipher, pp. 109-119; 1 fig.

No. 3. Note on the Glacial Drift in St. Louis. Note on the occurrence of blende in lignite. Recent additions to the mineralogy of Missouri. By H. A. Wheeler, pp. 121-131.

No. 4. Law of Minimum Deviation of Light by a prism, by Francis E. Nipher, pp. 133-136; 1 fig.

No. 5. Relations of *Salix missouriensis* Bebb to S. cordata Muhl., by N. M. Glatfelter, pp. 137-144; 2 pll.

No. 6. Flowers and Insects, by Charles Robertson, pp. 151-179.

No. 7. On a Rotational Motion of the cathode disc in the Crookes tube, by Francis E. Nipher, pp. 181-183.

No. 8. At What Age do pupils withdraw from the public schools? by C. M. Woodward, pp. 185-200.

No. 9. Geometrical Constructions of Lines of Force proceeding from (*a*) Two parallel electrified lines, (*b*) Two electrified points, by Wm. H. Roever, pp. 201-228; 9 figs.

No. 10. A Study of the Kansas Ustilagineæ, especially with regard to their germination, by J. B. S. Norton, pp. 229-241; 5 pll.

Missouri Botanical Garden, Wm. Trelease, Director:

Sixth Annual Report, 1895, 17 x 25 cm., bound in green cloth, gilt top, beveled edges, 134 pp.; 56 pll. Contains, in annual report of the director, 26 pp., 5 half-tone photos, the following scientific papers: A Revision of the North American species of *Sagittaria* and *Lophotocarpus*, by Jared G. Smith, pp. 27-64. pll. 1-29. *Leitneria floridana*, by Wm. Trelease, pp. 65-90; pll. 30-44, and 1 half-tone photo. Studies on dissemination of Yucca, by Herbert J. Webber, pp. 91-112; pll. 45-47. New or little-known species, by Jared G. Smith, pp. 113-119; pll. 48-56. Mound Flora of Atchison county, Missouri, by B. F. Bush, pp. 121-134.

Seventh Annual Report, 1896, 209 pp., 72 pll., including a number of half-tone photographs. Contains, in addition to Director's Report, the following scientific papers: Juglandaceæ of the United States, by Wm. Trelease, pp. 25-46; pll. 1-25, including 12 half-tone photos of hickory trees. Agaves of the United States, by A. Isabel Mulford, pp. 47-100; pll. 26-63, including 16 half-tones. Ligulate Wolffias of the United States, by Chas. Henry Thompson, pp. 101-111; pl. 64-66. Other articles are: "The value of the study of Botany," by Henry Wade Rogers, President of Northwestern University, an address delivered at the Sixth Annual Banquet of the Trustees of the Garden, and "The Sturtevant Prelinnæan Library," belonging to the Garden, pp. 113-209.

J. B. S. Norton, Author:

A Study of the Kansas Ustilagineæ, especially with regard to their germination, by J. B. S. Norton, from Trans. Acad. Sci. St. L., pp. 229-241; 5 pll.

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William Trelease, Author:

Botanical Opportunity, from Botanical Gazette, Vol. 12, 24 pp.

NEW JERSEY.

TRENTON.—*New Jersey Agricultural College Experiment Station, Byron D. Halsted, Botanist:*

Annual Report of Botanical Department for 1890, 130 pp.; 24 pll.; 6 figs.
Annual Report for 1891, 105 pp.; 24 ills.
Annual Report for 1892, 111 pp.; 35 ills.
Annual Report for 1893, 149 pp.; 73 ills.
Annual Report for 1894, 147 pp.; 81 ills.
Annual Report for 1895, 137 pp.; 70 ills.

NEW MEXICO.

LAS CRUCES.—*T. D. A. Cockerell, Author:*

The Smaller Bees of the genus Andrena, found in New Mexico, by T. D. A. Cockerell, 6 pp.
New Bees of the genus Halictus, from New Mexico, by T. D. A. Cockerell, 7 pp.
On a small collection of Coccidæ from the Island of Grenada, by T. D. A. Cockerell, 3 pp.

NEW YORK.

ALBANY.—*New York State Land Survey, Verplanck Colvin, Superintendent:*

Report on Progress, 1894, bound in green cloth, 406 pp.; 17 pll. Report on the Iron Deposits of the northeastern portion of the Adirondack region, with Industrial memoranda, pp. 159-176. Adirondack fishes, with descriptions of new species, from researches made in 1892, by Fred. Mather, pp. 177-240; 1 pl. Plants of the Summit of Mt. Marcy, by Chas. H. Peck, pp. 243-254. Lepidoptera of the Adirondack region, by J. A. Lintner, pp. 257-287. The Winter Fauna of Mt. Marcy, by Verplanck Colvin, pp. 291-303; 2 pll.

Joseph McDonough, "Ye Olde Booke Man":

Catalogues, regularly.

ALBION.—*Frank H. Lattin, Publisher:*

The Oologist, 1895, Nos. 1-4; 76 pp. Contains, besides other articles, Water Birds of Heron Lake, by P. B. Peabody, pp. 14-16. Notes on the Blue-headed Vireo in Massachusetts, by J. H. Bowles, pp. 21 and 22. Breeding time of our birds in the extreme part of Western New York, by Edward Reinecke, pp. 45-47. Norway's Bird Islands. Translated from Doctor Brehm's "From the North Pole to the Equator," by Agnes Gaines, pp. 65-69.

Walter F. Webb, Publisher:

The Museum: A Journal devoted exclusively to research in natural science. Vol. I, Nos. 3-12, 1895, pp. 65-380; numerous engravings. Contains, among other articles, Notes on the Nesting of the duck hawk, by William F. Wake, pp. 69 and 70. Industries of animals, by Frank C. Baker, pp. 71-76. Hudsonian Chickadee, by Winfred A. Stearns, pp. 76-78. The Chimney Swift, by C. O. Ormsbee, pp. 83-85. Vanilla and its cultivation, by F. H. Knowlton, pp. 88-90. Habits of certain rare northern birds in Commander Islands and Kamtskatka, by Leonhard Stejneger, pp. 101-102. Concretionary Granite, by C. O. Ormsbee, pp. 105 and 106. Coral, pp. 106-109. On the Preparation of Mammal Skins for Study, pp. 109-112, 138-141. Notes on Whistling Swan, by Nathan L. Davis, pp. 114-116. American Dipper, *Cinclus mexicanus*, by A. G. Prill, pp. 116-118. Winter Birds, by W. S. Johnson, pp. 118 and 119. The Rodents of Michigan, by Morris Gibbs, pp. 145-152. An Ancient Lake in Central Vermont, by C. O. Ormsbee, pp. 172-176, 200-202. Notes on the reported extinction of the genus *Achatinella* and marvelous development of a *Florida fasciolaria*, by John Ford, pp. 180-181. Red-shouldered Hawk, by Arthur M. Farmer, pp. 187-188. The American flamingo, by Adolphe B. Covert, pp. 202-204. Asphaltum and the Pitch Lake of Trinidad, by W. O. Crosby, pp. 205-210. New or little-known plants, pp. 211-214. An Arizona agave, pp. 215 and 216. The swallow-tailed kite, *Elanoides forficatus*, pp. 229-233. *Cypræa*, by Dr. T. H. McCoy, pp. 233-236. Directions for collecting and preserving fish, by Tarleton H. Bean, pp. 236-240. The Everglade Kite, pp. 242-246. Lobster Hatching at the Woods Holl, Mass., station of the U. S. F. C., by C. C. Purdum, pp. 247-248. Occurrence of nickel ore at Keokuk, Iowa, by Geo. M. Crofts, pp. 248-249. Changes in land and sea, by Chas. T. Whiting, pp. 266-268, 297-299. The Florida gopher or land tortoise, by Charles H. Coe, pp. 299-302. Giant kites for scientific purposes, pp. 302, 303. An Hour with Baird's and Leconte's sparrows near St. Louis, Mo., by O. Widman, pp. 305-309. The American crow, pp. 309-316. The Great Auk, *Alca impennis*, pp. 325-327. Notes on hibernating mammals, by C. C. Abbott, pp. 327-330. Our friend, the skunk, by W. H. Kitchell, pp. 332-336. Breeding habits of toads, by F. P. G., in "Outdoor World," pp. 339-340. Meteorites, pp. 345-350. Keokuk Geology, by Geo. M. Crofts, pp. 358-360. Notes on the northern raven in Maine, by A. H. Norton, pp. 361-363. The gigantic birds of Southern Patagonia, pp. 363-368.

Vol. II, Nos. 1-3 and 5-12. Showy sea shells, pp. 17-22; 21 figs. The summer cruise of the Albatross, pp. 41-45; 3 ills. Showy sea shells, pp. 69-72; 13 figs. Rare birds in Ontario, by J. Maughan, pp. 128-131. The Antarctic continent, by C. O. Ormsbee, pp. 240-245.

Vol. III, Nos. 1 and 2. Land and fresh-water shells of Dodge county, Wisconsin, pp. 11-12.

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HAMILTON.—*Colgate University, Department of Geology:*
Circular of Information, Courses of Instruction, etc., 1894-'95, 20 pp.

A. P. Brigham, Colgate University:
The Composite Origin of Topographic Forms, by Albert Perry Brigham, Bulletin Am. Geog. Soc., Vol. XXVII, pp. 161-174.
Drift Boulders between the Mohawk and Susquehanna Rivers, by A. P. Brigham, pp. 213-228. American Journal of Science, Vol. XLIX, March, 1895.
The New Geography, by Albert Perry Brigham, 8 pp. Appleton's Popular Science Monthly for April, 1896.

ITHACA.—*Cornell University—Agricultural Experiment Station:*
Bulletins.

M. V. Slingerland, Cornell University:
Bulletin No. 93, Entomological Division. The Cigar-Case-Bearer in Western New York, by M. V. Slingerland, pp. 213-230; 11 figs.
No. 104. Climbing Cutworms in Western New York, by M. V. Slingerland, pp. 553-600; 5 pll.; 2 figs.
No. 107. Wireworms and the Bud Moth, by M. V. Slingerland, pp. 35-66; figs. 14-39.
No. 108. The Pear Psylla and the New York Plum Scale, by M. V. Slingerland, pp. 68-86; figs. 40-47.
No. 123. Entomological division, December, 1896. Green Fruit Worms, by M. V. Slingerland, 14 pp.; 4 pll.

NEW BRIGHTON.—*Natural Science Association of Staten Island:*
Proceedings, Vol. IV, Nos. 13-20, pp. 56-89, title page and index.
Vol. V, Nos. 1-10, 97 pp., title page and index.
Vol. VI, Nos. 1 and 2, 10 pp.

NEW YORK.—*Linnæan Society of New York:*
Abstract of the Proceedings for the year ending March 7, 1890, 10 pp.
For the year ending March 26, 1895, with notes on Cuban mammals, by Juan Gundlach, and salamanders found in the vicinity of New York city, with notes upon extra-limital or allied species, by William L. Sherwood, 42 pp.
For the year ending March 24, 1896, the Snakes found within 50 miles of New York city, by R. L. Ditmars, 18 pp.

New York Academy of Sciences:
Transactions Vol XIV, 281 pp.; 49 pll. On Fluoplumbates, by Bohuslav Brauner, pp. 1-6. Dislocation in certain portions of the Atlantic coastal plain strata and their probable causes, by Arthur Hollick, pp. 8-20; 5 figs. On Enumeration of the plants collected by Dr. T. E. Wilcox and others, in southeastern Arizona in 1892-'94, by N. L. Britton and T. H. Kearney, jr., pp. 21-44. Additional notes on the classification of lepidopterous larvæ, by Harrison G. Dyar, pp. 49-62; 4 figs. On a granite-diorite near Harrison, Westchester county, N. Y., by Heinrich Ries, pp. 80-86; 4 figs. Notes on certain variations in the Biological characters of two species of bacteria, pp. 94-99. The Protolenus Fauna, by G. F. Matthew, pp. 101-153; 11 pll. A study of the Polarization of the light emitted by incandescent solid and liquid surfaces, by R. A. Millikan, pp. 155-185; 6 figs. Effusive and dike rocks near St. John, N. B., by W. D. Matthew, pp. 187-218; 6 pll.; 2 figs. Observations on the yolk nucleus in the eggs of *Lumbricus*, by Gray N. Calkins, pp. 222-230; 5 figs. The significance of muscular variations, illustrated by reversions of the antibrachial flexor group, by Geo. S. Huntington, pp. 231-259; 30 pll. Two new Cambrian graptolites, with notes on other species of Graptolitidæ of that age, by G. F. Matthew, pp. 262-273; 2 pll.; 1 fig.
Catalogue of Exhibits, March 13, 1895, 54 pp.; 1 fig.

New York Botanical Garden:
Bulletin of the New York Botanical Garden, Vol. I, No. 1, 21 pp.; 1 map.

New York Microscopical Society:
New York Microscopical Journal, a quarterly magazine, Vol. XI, Nos. 1-3, 1895, 96 pp.; pll. 45-51. The Dermal Armor of the Sturgeon, by George William Kosmak, pp. 1-21; pll. 45-48. Some remarks on clarification, and also on a new clarifier for microscopical purposes, by Edwin A. Schultze, (from the German of Dr. Wilhelm Lenz, Zeitschr. f. wiss. Mikr. xi, 16, 1894,) pp. 22-26. Notes on the seventeen-year cicada, *Cicada septendecim*, by E. G. Love, pp. 37-46; pl. 49 (colored). An undescribed *Vasicola* with an interesting habit, by Dr. Alfred C. Stokes, pp. 47-51 (illustrated). Interesting features of well-known plants of New York harbor, by Carlton C. Curtis, pp. 63-73; pll. 50 and 51. The Relation of aperture to the determination of minute structure, by Charles F. Cox, pp. 74-85.

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Arthur Chamberlain, Editor:

The Mineral Collector, Vol. II, Nos. 10-12, pp. 147-192; 8 pll.
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in Bolivia, 1885-'86, by Elizabeth G. Britton, pp. 471-499. On the formation of the circular Muskeg in tamarack swamps, by Conway MacMillan, pp. 500-507; 3 pll. The North American species of *Agrimonia*, by Eugene P. Bicknell, pp. 508-523; 2 pll. Terminology among the orders of Thallophytes, by L. M. Underwood, pp. 526-532. New species of *Nitella*, by T. F. Allen, pp. 533-536; 3 pll.

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Transactions, 1894-'96, 309 pp. Diatoms, by D. B. Ward, pp. 66-85. Bacteria, by D. B. Ward, pp. 188-205. Ento-parasites and hygiene, by Theo. Neumann, pp. 206-248. Tuberculosis, by J. W. Poucher, pp. 248-265.

ROCHESTER.—*Rochester Academy of Science:*

Brochure 4 of Vol. II, 1895, pp. 289-384, with volume index and contents.

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FARGO.—*North Dakota Agricultural Experiment Station:*

Annual Reports: 1891, 17 pp.; 1892, 24 pp., 2 pl.; 1895, 20 pp.; 1896, 14 pp.

Bulletins: No. 1, January, 1891, grain smuts, 28 pp., 7 figs.; No. 2, small fruits, 18 pp.; No. 5, sugar beets, 50 pp., 2 pll., 4 figs.; No. 6, the mustard family, 19 pp., 7 pll.; No. 8, wheat growing and dairying in North Dakota, 14 pp.; No. 9, rheumatism in horses, 15 pp., 5 ills.; No. 11, grain and forage crops, 32 pp.; No. 12, transplanting onions, 10 pp., 7 figs.; No. 14, tuberculosis, 13 pp.; No. 15, chemical composition of foods, 14 pp.; No. 13, rational selection of wheat for seed; typhoid fever, 31 pp., 11 figs.; No. 16, dairy herd record, 1894, etc., 24 pp.; No. 17, effect of seed exchange upon culture of wheat, etc., 20 pp., 2 ills.; No. 18, some profitable vegetables from North Dakota, 16 pp.; No. 19, treatment of smut for wheat; treatment of potato scab, 11 pp., 2 figs.; No. 20, rations for horses, 18 pp.; No. 21, cleanliness in handling milk, 20 pp., 6 figs; No. 22, the creamery industry, 27 pp., 15 ills.; No. 23, grain and forage crops, 24 pp.; No. 24, North Dakota soils, 17 pp.; No. 25, tree culture, 11 pp.; No. 26, feeding of millet to horses, 17 pp.; No. 27, new studies upon smuts, 54 pp., 13 figs.

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AKRON.—*E. W. Claypole, Buchtel College, Author:*

On the Teeth of Mazodus, by E. W. Claypole. From Proceedings of American Microscopical Society, 1896. 3 pp. On the structure of some Paleozoic spines from Ohio, 2 pp.

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Third annual report, 1894, 68 pp.; 1 pl.

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Laboratory Bulletin No. 3. Bird migration at Grinnell, Iowa, and Oberlin, Ohio, by Lynds Jones, 72 pp. 4. Questions for Botany, 11 pp. 5. Hertwig's summaries in systematic zoology, translated by Albert A. Wright, 35 pp.

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Our Library, Vol. I, 1895, Nos. 20-24, pp. 77-116. Vol. II, 1896, Nos. 1-5, pp. 1-20.

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of North America, by Samuel N. Rhoads, pp. 351-376; 4 pll. New and little-known mammalia from the Kennebec bone deposit, by E. D. Cope, pp. 378-394. Insular land shell faunas, by William H. Doll, pp. 395-460; 3 pll. On the hemispheres of the sauria, by E. D. Cope, pp. 461-467.

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KNOXVILLE.—*University of Tennessee Agricultural Experiment Station:*

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NASHVILLE.—*State Board of Health:*

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perimental verification, by W. H. Von Streeruwitz, pp. 61-69. On the Biogeography of Mexico, Texas, New Mexico, and Arizona, by C. H. Tyler Townsend, pp. 71-96.

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Annual Reports: 1894, 200 pp.; 25 figs. 1895, 240 pp.; 4 pll.; 42 figs.

Bulletins: No. 43. Household pests, 6 pp.; 4 figs. 44. Spraying orchards and potato fields, 22 pp.; 15 figs. 45. Analysis of commercial fertilizers, 8 pp. 46. Analysis of commercial fertilizers, 12 pp. 47. Commercial fertilizers, 44 pp. 48. Gluten feeds and meals, 16 pp.; 1 fig. 49. Potato blights and fungicides, 18 pp.; 4 figs. 54. Salad plants and plant salads, 13 pp. 55. Apple-growing in Grand Isle county, 13 pp.; 9 figs.

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MILWAUKEE.—*Public Museum of the City of Milwaukee:*

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LARAMIE.—*University of Wyoming:*

Departments of chemistry and engineering. Special bulletin, January, 1896. Heating power of Wyoming coal and oil, by Edwin E. Slosson and L. C. Colburn, 32 pp.

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CHICOUTIMI.—*V.-A. Huard, Publisher:*

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ville, par l'Abbe P. Begin, pp. 74-77, 92-94. Les dernieres descriptions de l'Abbe Provancher, pp. 79-80, 110-112, 129-131, 140-142, 157-159, 172-176.

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Proceedings and Transactions, Vol. VIII, Part IV, pp. 381-470. On the measurement of the resistance of electrolytes, by F. J. A. McKittrick, pp. 381-390. Notes on Nova Scotia zoology, by Harry Piers, pp. 395-410. Notes on collection of silurian fossils from Cape George, Antigonish county, N. S., by Henry M. Ami, pp. 411-415. Recent sedimentary formations on Bay of Fundy coast, by R. W. Ells, pp. 416-419. Deep mining in Nova Scotia, by W. H. Prest, pp. 420-434. Note on the Sidney coal field, by E. Gilpin, pp. 435-438. List of plants collected in and around Shelburne, by George H. Cox, pp. 439-444. Phenological observations made at stations in Nova Scotia and New Brunswick, by A. H. MacKay, pp. 451-455.

Vol. IX, Part I, pp. xx+100; 5 pll. Notes on concretions found in Canadian rocks, by T. C. Weston, pp. 1-9; 6 figs. Iron ores of Nictaux, N. S., by E. Gilpin, jr., pp. 10-20. True surfaces and accurate measurements, by D. W. Robb, pp. 21-25. Relics of the stone age in Nova Scotia, by Harry Piers, pp. 26-58; 3 pll. Phenological observations, by A. H. MacKay, pp. 59-63. Foraminiferous deposit from the bottom of the North Atlantic, by A. H. MacKay, pp. 64-67. Notes on the geology and botany of Digby Neck, by L. W. Bailey, pp. 68-82; 3 pll. The flora of Newfoundland, Labrador, and St. Pierre et Miquelon, Part II, by Arthur C. Waghorne, pp. 83-100.

Vol. IX, Part II, pp. xxi-lxxx + 101-218; 4 pll. Conductivity of mixtures of electrolytes, by J. G. MacGregor, pp. 101-119; 1 fig. Calculation of conductivity of mixtures of electrolytes having a common ion, by Douglas McIntosh, pp. 120-133. The undeveloped coal-fields of Nova Scotia, by E. Gilpin, jr., pp. 134-149. Notes on the geology of Newfoundland, by T. C. Weston, pp. 150-157. Glacial succession in central Lunenburg, by by W. H. Prest, pp. 158-170. Notes on the superficial geology of Kings county, N. S., by A. E. Coldwell, pp. 171-174. On an arborescent variety of *Juniperus communis*, by J. Somers, pp. 175-179. Some Nova Scotian illustrations of dynamical geology, by L. W. Bailey, pp. 180-194; 3 pll.; 2 figs. Phenological observations, by A. H. MacKay, pp. 195-207. Preliminary notes on Orthoptera of Nova Scotia, by Harry Piers, pp. 208-218.

HAMILTON, ONT.—*Hamilton Association:*

Journal and Proceedings, 1894-'95, No. XI, 103 pp. Early Indian history, by P. E. Jones, pp. 17-23. Brief notes on the Devonian and other rocks, Ontario, by C. C. Grant, pp. 65-78. Glacial man controversy, etc., by C. C. Grant, pp. 79-84. Hamilton sponges, by A. E. Walker, pp. 85-87; 5 figs.

1895-'96, No. XII, 184 pp. Acetylene gas, by Geo. Black, pp. 18-27. Notes regarding local graptolites, by C. C. Grant, pp. 159-163. Notes on the Pipestone district, Manitoba, by J. A. Donahy, pp. 164-174.

MONTREAL, QUE.—*British Association for the Advancement of Science:*

Handbook of Canada, 336 pp.; 2 maps.

Royal Society of Canada:

Proceedings and Transactions, Vol. XII, 1894, 551 pp.; 12 pll. Bibliography of the members of the Royal Society of Canada, pp. 5-79, Section II. Inuits of our Arctic Coast, by J. C. Schultz, pp. 113-134. Section III. On the strength of Douglas fir, white pine, and red pine, by H. T. Bovey, pp. 11-18. Observations on some structural variations in certain Canadian Coniferæ, by D. P. Penhallow, pp. 19-42; 4 pll.; 3 figs. Notes on errors in meridian transit observations, by C. H. McLeod, pp. 43-46. Quality of air in Ottawa, by F. T. Shutt and A. McGill, pp. 47-48. Section IV. Canadian Forests, by John Macoun, pp. 3-20. Potsdam and calciferous formations of Quebec and eastern Ontario, by R. W. Ells, pp. 21-30. Psychic development of young animals and its physical correlation, by Wesley Mills, pp. 31-62. L'Eboulis de St. Alban, par Mgr. Laflamme, pp. 63-70. Synopsis of air-breathing animals of the Paleozoic in Canada, to 1894, by Sir Wm. Dawson, pp. 71-88. Organic remains of Little River group, II, by G. F. Matthew, pp. 89-111; 1 pl. Sponges from Western coast of North America, by Lawrence M. Lambe, pp. 113-138; 3 pll. Cross-fertilization at experimental farms, by Wm. Saunders, pp. 139-144. Preservation of fruit for museum purposes, by Wm. Saunders, pp. 145-146. Fossil cockroaches of North America, by Samuel H. Scudder, pp. 147-153. Size, 23x30 cm.

Proceedings and Transactions, Second Series, Vol. I, 1895, 16 x 24 cm., bound, 848 pp.; 14 pll. Section II. An Iroquois condoling council, by Horatio Hale, pp. 45-65. The

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present condition of American Anthropology, by John Campbell, pp. 67-79. Later Prehistoric man in New Brunswick, by Charles Hill-Tout, pp. 103-122. Haida Grammar, by C. Harrison, pp. 123-226. Section III. Advances in mineralogical chemistry, by B. J. Harrington, pp. 3-17. Note on secondary undulations recorded by self-registering tide gauges, by W. Bell Dawson, pp. 25-27; 2 pll. Theory of the screen in the photo-mechanical process, by E. Deville, pp. 29-61; 31 figs. Results of observations of soil temperatures with electrical resistance thermometers, by Hugh L. Callendar, pp. 63-83; 6 figs. On the hypothesis of abstract dynamics, by J. G. MacGregor, pp. 85-95. Viscosity in liquids and instruments for its measurement, by Anthony McGill, pp. 97-103; 2 figs. Section IV. Practical Entomology, by James Fletcher, pp. 3-15. Preliminary catalogue of marine mollusca of the Pacific coast of Canada, with notes upon their distribution, by George W. Taylor, pp. 17-100. Notes on some Cretaceous fossils collected during explorations in British North America, by J. R. Whiteaves, pp. 101-117; 1 pl. Fossils from Vancouver Cretaceous, etc., by J. E. Whiteaves, pp. 119-136; 2 pll. Tertiary Plants from Vancouver, by Sir William Dawson, pp. 137-161; 5 pll. Physical features and geology of Ottawa canal, by R. W. Ells and A. E. Barlow, pp. 163-190; 1 map. Psychic development of young animals and its physical correlation, by Wesley Mills, pp. 191-252. Traces of the Ordovician system on the Atlantic coast, by G. F. Matthew, pp. 253-271; 2 pll. Organic remains of the Little River group, by G. F. Matthew, pp. 273-279; 1 pl.

Natural History Society of Montreal:

Canadian Record of Science, Vol. VI, 1894-'95, 503 pp. Batrachian and other air breathers in coal formation of Nova Scotia, by J. William Dawson, pp. 1-7; 1 fig. Record of Canadian earthquakes, by J. William Dawson, pp. 8-16. Check-list of European and North American Mosses, by N. Conn Kindberg, pp. 17-23, 72-76. Contributions to Canadian Botany, by James M. Macoun, pp. 23-27, 76-88, 141-153, 198-210, 264-276, 318-329, 405-415, 459-469. Composition of limestones and dolomites of Canada, by B. J. Harrington, pp. 27-32. On the formation of pegmatite veins, by Brogger, pp. 33-46, 61-71. Limestones of Laurentian system, by E. D. Ingall, pp. 88-91. Ancient myriapods, by G. F. Matthew, pp. 93-99. Bivalve shells of the coal formation of Nova Scotia, by J. William Dawson, pp. 117-134, 167; 15 figs. Parasitic Protozoa, by W. E. Deeks, pp. 158-164. On the Norian or Upper Laurentian formation of Canada, by Frank D. Adams, pp. 169-198, 277-305; 7 figs.; 416-443; 2 maps. The apatite-bearing rocks of the Ottawa district, by R. W. Ells, pp. 213-222. Notes on Canadian fossil Bryozoa, by H. M. Ami, pp. 222-229. The Rideau lakes, by A. T. Drummond, pp. 230-238. Remarkable flight of birds of Atlantic coast up St. Lawrence river to the Great Lakes, by E. D. Wintle, pp. 245-248; 1 pl. Canadian Unionidæ, by J. F. Whiteaves, pp. 250-263, 365-366. A caddis fly from the Leda clays, by Samuel H. Scudder, pp. 276-277; 1 fig. Notes on some fossils from the Cretaceous rocks of British Columbia, by J. F. Whiteaves, pp. 313-318; 1 pl. Gold deposits of Mt. Morgan, Queensland, by Frank D. Adams, pp. 329-341; 2 figs. Rarer summer flowers of Canada, by Robert Campbell, pp. 342-351. Timber of Canada, by J. K. Ward, pp. 354-365. New fossils from Trenton limestone of Lake Winnipeg and the Red river valley, by J. F. Whiteaves, pp. 388-397. Flora of Montreal Island, by Robert Campbell, pp. 397-405. Review of the evidence for the animal nature of *Eozoon canadense*, by Sir William Dawson, pp. 470-478; 4 figs. Dikes cutting Laurentian system in Ontario, by W. G. Miller and R. W. Kingston, pp. 481-488; 1 pl. On ferns of Montreal, by Harold B. Cushing, pp. 488-494. Gold and silver ores of the Slocan, by J. C. Gwillim, pp. 494-498.

Vol. VII, Nos. 1-3, pp. 1-202. Description of a supposed new genus of Polyzoa from the Trenton limestone at Ottawa, by Lawrence M. Lambe, pp. 1-3; 1 pl. Notes upon the Flora of Newfoundland, by B. L. Robinson and H. von Schrenk, pp. 3-31. Charcoal impregnated with slag, by D. P. Penhallow, pp. 34-39. Contributions to Canadian Botany, by James M. Macoun, pp. 39-50. Currents and Temperatures of the Gulf of St. Lawrence, Andrew T. Drummond, pp. 50-57. Review of the evidence for the animal nature of *Eozoon canadense*, by Sir William Dawson, pp. 62-77; 3 figs. On a new alkali hornblende, by Frank D. Adams and B. J. Harrington, pp. 77-88. Lecture on Acetylene, by J. M. Crafts, pp. 88-117. Canadian Stomatoporoids, by J. F. Whiteaves, pp. 129-146. Flora of Montreal Island, by Robert Campbell, pp. 146-151. *Nematophyton crassum*, by D. P. Penhallow, pp. 151-156; 1 pl. Precambrian fossils, especially in Canada, by Sir Wm. Dawson (abstract), pp. 157-162. Distinctive characters of Canadian spruces, *Picea*, by George Lawson, pp. 162-175. Segregation in ores and mattes, by David H. Browne, pp. 176-190; 10 figs.

OTTAWA, ONT.— *Department of Agriculture:*

Statistical year-book of Canada, compiled by George Johnson; for 1894, 1134 pp.: for 1895, 1007 pp.

Geological and Natural History Survey of Canada, Alfred R. C. Selwyn, Director:

Vol. VI, 1892-'93; 634 pp.; 10 pll. Preliminary Report on Geology of Nova Scotia, by L. W. Bailey, pp. 1-21 Q. Chemical Contributions to the Geology of Canada, by G. C. Hoffman, pp. 1-93 R. Mineral Statistics, by E. D. Ingall and H. P. H. Brumell, pp. 1-212 S.

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Vol. VII, 1894, G. M. Dawson, Director, 1208 pp.; 8 pll.; 3 maps. Report on area of Kamloops map-sheet, by Geo. M. Dawson, pp. 1-427 B; 7 pll.; 17 figs; 2 maps (in folio). Exploration of the Finlay and Omenica Rivers, by R. G. McConnell, pp. 1-40 C; 2 pll.; 1 map (in folio). Red Lake and Keewatin basins, by D. B. Dowling, pp. 1-54 F; 1 map. Report on Montreal sheet with chapter on Laurentian, by R. W. Ells and F. D. Adams, pp. 1-157 J; 1 map (in folio). Surface geology of eastern New Brunswick and northwestern Nova Scotia, by Robert Chalmers, pp. 1-194 M; 4 pll.; 2 maps, (3 maps in folio). Report of section of chemistry and mineralogy, by G. C. Hoffman, pp. 1-68 R. Mineral statistics and mines, by E. D. Ingall, pp. 1-187 S.

Maps, in folio, of auriferous creeks in Cariboo mining districts, B. C., by Amos Bowman. Maps are: Williams creek, Lightning creek, Antler creek, Grouse creek, Cunningham creek, Little Snowshoe and Keithley creeks, Hardscrabble and Slough creeks, Harvey creek, and sections along Harvey creek. To accompany Vol. III, 1887-'88.

Maps of the following sheets of Nova Scotia: Guysborough, Whitehaven, Isaacs Harbour, Georgian, Seabrooke, Country Harbour, Roman Valley, Pomquet Harbour, Cape George, Antigonish, Lochaber, West River St. Marys, Liscomb River, and Moser's River. To accompany Part II, Vol. II, 1886.

Ottawa Field Naturalists' Club:

The Ottawa Naturalists' Monthly, Vol. IX, 1895, 262 pp. Dikes containing Huronite, by A. E. Barlow, pp. 25-47. Stratigraphy of Cambro-Silurian rocks of Manitoba, by D. B. Dowling, pp. 65-74, pl. Land and fresh-water shells of Alberta, Canada, by Geo. W. Taylor, pp. 173-178. Notes on the flora of Ontario, by John Macoun, pp. 217-225.

Vol. X, Nos. 1-9, 184 pp. Petrographical notes on Archæan rocks, by John A. Dresser, pp. 129-133. New species of graptolites, by H. M. Ami, pp. 145-147. Fauna Ottawaensis, by W. H. Harrington, pp. 174-178.

TORONTO, ONT.— *Canadian Institute:*

Eighth Annual Archæological Report, appendix to Report of Minister of Education, Toronto, 1894-'95, by David Boyle, 79 pp.; 4 pll.; 66 figs.

Transactions, Vol. IV, Part 2, December, 1895. Social organization of Blackfoot Indians, by John Maclean, pp. 249-260.

Vol. V, Part 1, October, 1896. Fluctuations in Lake Ontario, by Kivas Tully, pp. 37-43. Gesture Language of the Blackfeet, by John Maclean, pp. 44-48. Aboriginal American inscriptions, by John Campbell, pp. 53-63; 3 pll. Picture writing and language of the Blackfeet, by John Maclean, pp. 114-120, 128-165; 1 pll.

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Functions of a Great University, by J. M. Clark, 18 pp.

VICTORIA, B. C.— *Library of the Legislative Assembly, R. E. Gosnell, Librarian:*

British Columbia Mining Record, 1896, Vol. 2, Nos. 9, 11, and 12.

British Columbia Board of Trade, Seventeenth Annual Report, 1896, 80 pp.; 6 pll.

British Columbia: Its present resources and future possibilities, 110 pp.

Annual Report of the Minister of Mines, 1895, 93 pp.

Crown Land Surveys, 1895, 236 pp.; 2 maps.

Bulletin Natural History Society of British Columbia, 1893. Preliminary list of mammals of British Columbia, by John Fannin, pp. 1-3. New and rare fish of British Columbia, by Andrew H. Green, pp. 9-10. Entomology of British Columbia, by W. H. Danby and C. DeB. Green, pp. 11-18; 1 pl. Crustacea in the provincial museum, by C. F. Newcombe, pp. 19-30; 4 pll. Marine shells of British Columbia, by C. F. Newcombe, pp. 32-72.

Report on mining section in Alberni District, V. I., by W. J. Sutton, 7 pp.

Alaskan Boundary Question, by Alex. Begg, 17 pp.

Bulletins. 1. Report on Alberni mining district, by W. A. Carlyle, Provincial Mineralogist, pp. 1-8. 2. Report on Trail Creek mining district, by W. A. Carlyle, pp. 9-32.

Vancouver Island as a home for settlers, 24 pp.; 2 maps.

British Columbia: A Digest of reliable information, by R. E. Gosnell, 48 pp.

WINNIPEG, MAN.— *Historical and Scientific Society of Manitoba:*

Annual Report for 1894, 22 pp.; for 1895, 32 pp.

Transactions, 48. Worthies of Old Red River, by George Bryce, 12 pp.

MEXICO.

MEXICO.— *Academia Mexicana de Ciencias Exactas, Fisicas y Naturales:*

Anuario, Ano 1, 1895, 84 pp.

Instituto Geologico de Mexico:

Boletin Num. 1. Fauna fosil de la Sierra de Catorce, por Antonio del Castillo y Jose G. Aguilera, 55 pp.; 24 pll.

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Num. 2. Las Rocas Eruptivas del suroeste de la Cuenca de Mexico, por Ezequiel Ordonez, 46 pp.; 6 figs.

Num. 3. Sobre la Geografia Fisica y la Geologia de la Peninsula de Yucatan, por el Dr. Carlos Sapper, 57 pp.; 4 maps; 2 pll. of sections.

L'Observatoire Meteorologique Central de Mexico:

El Clima de la Ciudad de Mexico. Breve resena, por Mariano Barcena, 1893, 24 pp.

Boletin de Agricultura, Mineria e Industrias, 15x21 cm. Ano V, Num. 3-12, Setiembre, 1895-Junio, 1896, a total of 2,388 pp.; many tables.

Ano VI, Num. 1-3, Julio de 1896-Setiembre de 1896, 522 pp.

Boletin Mensual, 22x32 cm., Marzo, 1895-Diciembre, 1895, 180 pp.; maps and charts.

Mes de Enero, Marzo-Noviembre, 1896, 150 pp.; maps and charts.

Sociedad Mexicana de Historia Natural:

La Naturaleza, Periodico Cientifico, publicado bajo la direction del Sr. Dr. Manuel M. Villada. Tomo II. Numeros 8-11. La Sebastiania ramirezii, n. sp., por Paul Maury, pp. 405-407, pl. "Semillas Brincadoras," por Jose Ramirez, pp. 408-410. Hemichirotes tridactylus'A. Dug., y nueva especie de *Trombidio mexicano*, por Alfredo Duges, pp. 411-416, pl. Una especie nueva de Pterostemon, por Jose Ramirez, pp. 416-420; 1 pl. Felis fosil de San Juan de los Lagos, por Alfredo Duges, pp. 421-423, 1 pl. Las Calagualas, y Bosquejo de Flora Tabasquena, por Jose N. Rovirosa, pp. 430-441; 1 pl. Un Caso de Osteomalacia en el leon de Mexico (*Felis concolor*), por Alfonso L. Herrera, pp. 442-444. La *Mocinna heterophylla* La Llave, pp. 445-451; 3 pll. Un nuevo jahuique (*Trigrida dugesi*), por Alfredo Duges, pp. 453-456, 4 pll. colored. Un Mariposa Nueva (*Ophideres raphael*), por A. Duges, pp. 456-459; 1 pl. col. *Amblystoma altimirani* A. Dug., por Alfredo Duges, pp. 459-461, 1 col. pl. Estudios de Antropologia Mexicana, por Alfonso L. Herrera y Ricardo E. Cicero, pp. 462-469. La Zoologia de Colon y de los primeros exploradores de America, pp. 472-476. Intestino del *Crocodilus americanus*, y reptiles y batracios dos Estados Unidos de Mexicanos, por Alfredo Duges, pp. 477-485, 2 figs. La goma laca de Mexico, por Manuel Villada, pp. 486-488, 1 pl. *Casimiroa pubescens*, por Manuel M. Villada, p. 492, 1 pl. *Tabebuia donnell-smithii*, por J. N. Rose, pp. 493-495. Especies del Viejo Mundo, pp. 496-502. Observaciones sobre la Reproduccion de la *Iguana tuberculata* Laur., por M. G. Peracca, pp. 502-507.

Carta de los Meteorites de Mexico, 27x37 cm., por Antonio del Castillo.

Bosquejo de una Carta Geologica de la Republica Mexicana, 27x37 cm., Antonio del Castillo.

Plano Geologico del Penon de los Banos, 43x61 cm.

Plano Geologico de la Minas de fierro, de la Encarnacion, y del Disto. Minero de S. Jose del Oro, 44x66 cm.

Plano Geologico y Petrografico de la Cuenca de Mexico, Region S. W., 27x45 cm.

Cortes Geologicos de Pozos Artesianos abiertos en la gran Cuenca de Mexico, 78x114 cm.

Carta Minera de la Republica Mexicana, 110x170 cm.

Plano de la Sierrita Metalifera al sur de Tapeyahualco, 50x50 cm.

Plano Topographico del Mineral de Tetela del Oro, 41x51 cm.

Plano Geologico Minero del Real de S. Antonio y el Triunfo de la Baja California, 55x66 cm.

Sociedad Cientifica "Antonio Alzate":

Memorias y Revista, Tomo IX, Numeros 1-10. Temperatura interna de la Tierra, por Manuel Moreno y Anda, pp. 123-137. Periodos criticas en la historia de la Tierra, por J. Le Conte, pp. 1-12, 20-23, 51-57, 62-76. La Atmosfera de los Altitudes y el binestar del hombre, por Alfonso L. Herrera y Daniel Vergara Lope, pp. 164-193. Les "Heresies Taxinomistes," by Alphonse L. Herrera, pp. 13-60, 15-19, 36-39, 49-50. Les Musees de l'Avenis, par Alphonse L. Herrera, pp. 221-252. Determination de la densite normale du *sang* a Mexico, par Daniel Vergara Lope, pp. 305-307; 1 chart. El Pie de los monos, por Alfredo Duges, pp. 325-327; 1 pl. Comparacion entre el Esqueleto de la Ave y el de la Tortuga, por Alfredo Duges, pp. 329-331; 1 pl.

WEST INDIES.

HAVANA, CUBA.— *Dr. Antonio Gordon, Universite de la Havane:*

Los Incendios, los Bomberos y la Higiene, por Dr. D. Antonio de Gordon y de Acosta, 1894, 15x22 cm., 73 pp.

Discurso conmemorativo de la Fundacion de la Real Academia de Ciencias Medicas, Fisicas y Naturales, por Dr. Antonio de Gordon y de Acosta, 1896, 17x25 cm., 36 pp.

KINGSTON, JAMAICA.— *Botanical Department of Jamaica:*

Bulletins, 20x32 cm., edited by William Fawcett, Nos. 1-50; 1887-'93. Ferns: Synoptical list, with description of ferns and fern allies of Jamaica, by G. S. Jenman.

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Bulletins. Vol. I, Nos. 1-12, 1894; 200 pp. Ferns: Synoptical list, with descriptions of the ferns and fern allies of Jamaica, by G. S. Jenman, pp. 28-30, 60-62, 75-78, 85-94.

Vol. II, Nos. 1-12, 1895, 296 pp. Ferns: Synoptical list, with descriptions of the ferns and fern allies of Jamaica, by G. S. Jenman, pp. 195-198, 266-270.

Vol. III, Nos. 1-12, 1896, 315 pp. Ferns: Synoptical list, by G. S. Jenman, pp. 20-22, 45-47, 66-68, 93-94, 110-116, 141-143, 162-166, 188-190, 211-213, 236-238, 260-262.

TRINIDAD, TRINIDAD.—*Victoria Institute*:

Proceedings of the Victoria Institute of Trinidad, part 2, 1895. A Helicina and Classification of the Helicinidæ, by R. J. L. Guffy, pp. 72-77. Mammals of Trinidad, pp. 78-80. Birds of Trinidad, pp. 81-96. Orthoptera of St. Vincent and Grenada, W. I., pp. 99-101. Observations upon the physical conditions and fauna of the Gulf of Paria, by R. J. L. Guffy, pp. 105-152.

R. J. Lechmere Guffy:

Microzoa of the Tertiary and other rocks of Trinidad and the West Indies, by R. J. L. Guffy, 14 pp.

SOUTH AMERICA.

ARGENTINA.

BUENOS AIRES.—*Museo Nacional, Prof. Dr. Carlos Berg, Director:*

Anales, 18x27 cm., Tomo IV (Ser. 2a, t. I). Enumeracion Sistematise y Sinonimica de los Peces de los Costas Argentina y Paraguay, por Carlos Berg, pp. 1-120. Sobre Peces de agua dulce nuevos o poco conocidos de la Republica Argentina, por Carlos Berg, pp. 120-165. Arachnides Recueillis a la Terre-de-feu, par M. Carlos Backhausen, par Eug. Simon, pp. 167-172. Cuatro Gramineas nuevas y uno poco conocida de la Republica Uruguaya, por J. Arechavaleta, pp. 177-187. Dos Reptiles nuevos, por Carlos Berg, pp. 189-194; 2 figs. Hemipteros de la Tierra-del-fuego, por Carlos Berg, pp. 195-206. Etude comparee sur des molaires de *Toxodon* et d'autres representants de la meme famille, por Alcide Mercerat, pp. 207-214; 1 pl. Revision et description des especes Argentines et Chiliennes du genre *Tatochila buti*, por Carlos Berg, pp. 217-255; 5 figs. Construction a l'etude systematique des *Toxodontia*, por Alcide Mercerat, pp. 257-306. Los criaderos del espato fluor de San Roque, en la provincia de Cordoba, por Juan Valentin, pp. 307-314.

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Anales, Tomo XXXVIII, 1893. Un Viaje a Misiones, por Juan B. Ambrosetti, pp. 31-66; 8 ills. Explotacion y Tarifas de ferrocarriles, por Miguel Tedin, pp. 67-104. Proyecto de instalacion para una Fabrica de cal comun, por Angel Gallardo, pp. 113-222; 8 pll. Fenomenos sismicos, por Angel Cantoni, pp. 223-230. Flores e Insectos, por Angel Gallardo, pp. 240-269; 1 pl.; 8 figs.

Tomo XXXIX, 1894. Teoria del Trazado de Ferrocarriles, por Alberto Schneidewind, pp. 1-76; 3 pll. Tesoro de Catamarquenismos, por S. A. Lafone Quevedo, pp. 77-109. Proyecto de Canal de Irrigacion, por Miguel Olmos, pp. 129-182; 5 pll. Proyecto de Puente continuo articulado, para Ferrocarril, por Carlos Albarracin, pp. 193-236; 5 pll. Proyecto de puente giratorio, por Emilio Palacio, pp. 241-283; 1 pl.; 1 fig.

Vol. XL, 1895. Proyecto de puente giratorio, por Emilio Palacio, pp. 1-47; 6 pll. Metode Racional para el Relevamiento do un plano catastral, por Edmundo Soulages, pp. 61-76. Teoria del Trazado de ferrocarriles, por Alberto Schneidewind, pp. 77-209; 1 pl. Notas de estatica grafica, por C. Paquet, pp. 210-239. Conductos de tormenta, por Carlos Echaque, pp. 241-290.

Appendix. Enumeration Synoptique des especes de Mammiferes fossiles des formations Eocenes de Patagonie, por Florentino Ameghino. Fevrier, 1894, 196 pp.; 66 figs.

Tomo XLI, 1895. Viaje a los Andes Australes, por Ramon Lista, pp. 5-35; 2 pll.; pp. 108-138; 3 pll.; 145-170. Costumbrez y Supersticiones en los Valles Calchaquies, por Juan B. Ambrosetti, pp. 41-85; 2 pll.; 6 figs. Teoria del Trazado de los ferrocarriles, por Alberto Schneidewind, pp. 185-243; 1 pl. Canerias de Agua corriente y de las cloacas, por Emilio Lejeune, pp. 244-251, 257-272, 305-320. Una Mision Cientifica, por Emilio R. Coni, pp. 273-285, 366-391. Los Andes Patagonicas, por Ramon Lista, pp. 286-296; 1 pl. Le Leyende del *Yaguarete aba*, por Juan B. Ambrosetti, pp. 321-334. Idioma Mbaya, por Samuel A. L. Quevedo, pp. 339-364.

Tomo XLII, 1896. Las carioquinesis, por Angel Gallardo, pp. 5-34; 7 figs. Idioma Mbaya, por Samuel A. L. Quevedo, pp. 44-58, 145-164. Tableas para el calculo de las canerias de agua corriente y de las cloacas, por Emilio Lejeune, pp. 62-91. Exploraciones Antiguas en la Patagonia, por Ramon Lista, pp. 130-144; 1 pl. La Diagonalidad, por Claro Cornelio Dassen, pp. 165-188, 198-216. Semillas y frutas, por Angel Gallardo, pp. 217-253; 1 pl.; 17 figs. Un Paseo a los Andes, por Juan B. Ambrosetti, pp. 264-277; 8 pll. Tesoro de Catamarquenismos, por Samuel A. L. Quevedo, pp. 278-296, 367-384. Plantes Patagonicas, por Ramon Lista, pp. 384-395.

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CORDOBA.—*Academia Nacional de Ciencias:*

Boletin, Tomo XIV, 1894. Entrega 1a, Julio. El Periodo diurno y anuo de las tormentas en Cordoba, por Oscar Doering, pp. 5-54. La insolacion en Cordoba, por Oscar Doering, pp. 55-92. Los Criaderos de wolfram y molybdenita de la Sierra de Cordoba, por Guillermo Bodenbender, pp. 93-115. Entrega 2a, Agosto. Observaciones Magneticas, por Oscar Doering, pp. 117-292. El Terremoto Argentino del 27 de Octubre de 1894, por Guillermo Bodenbender, pp. 293-329.

BRAZIL.

RIO DE JANEIRO.—*Sociedade do Geographia do Rio de Janeiro:*

Revista, Tomo X, 1° ao 4° Boletins, 1894. Estudos sabre o Rio Branco. Conferencia do Torquato Tapajos, Sebastiao Diniz, pp. 1-33.

Tomo XI, 1895. Descobrimento do Brasil em 1500, Pero Vaaz de Caminha, pp. 1-74; 1 map.

S. PAULO.—*Museu Paulista, Publicada por Dr. H. von Ihering:*

Revista, Vol. I, 1895, 16x23 cm. A civilisaçao Prehistorica do Brazil Meridional, pelo H. von Ihering, pp. 35-159; 14 figs. Os Crustaceos Phyllopodes do Brazil, pelo H. von Ihering, pp. 165-180; 2 figs. *Distoma ophisthotrias*, um novo parasita do Gamba, pelo Adolpho Lutz, pp. 181-193; 1 pl. O veneno ophidico, pelo H. von Ihering, pp. 195-206. Os Unionidos da Florida, pelo H. von Ihering, pp. 207-222. Conchas Marinas da formaçao pampeana de la Plata, pelo H. von Ihering, pp. 223-231.

CHILE.

SANTIAGO.—*El Instituto de Hijiene de Santiago, Dr. F. Puga Borne, Director:*

Revista Chilena de Hijiene, Tomo II, 1893-'96, numeros 4-8, pp. 1-511.

Societe Scientifique du Chile:

Actes, 20x26 cm., Tome V, 1895, clx + 276 pp. A new species of Coccidæ of the genus *Diaspis*, by T. D. A. Cockerell, pp. 6-7. Description d'une nouvelle espece de *Gordius* du Chili, par Lorenzo Camerano, pp. 8-9. Deuxieme note sur les Fourmis du Chili, par C. Emery, pp. 10-18; 3 figs. Le *Dactylopius vitis* au Chili, par Fernand Lataste, pp. 24-30. Un utensilio del Antiguo Peru, por Perez Canto, pp. 31-33. Sur l'Age des terrains a lignite du sud du Chili, le group d'Arauco equivalent Chilien de groupe de Laramie de l'Amerique du Nord, par A. F. Nogues, pp. 34-52. Sur la coloration des microphytes a l'aide du carbonate de lithine, par Clodomiro Perez Canto, pp. 53-54. Examen comparatif de l'œuf de l'effraye du Chili, par Xavier Raspail, pp. 55-62. Nouvelle observations sur les mœurs et les manifestations phonetiques de l'effraye sud-Americaine (*Strix perlata* Licht.), par Fernand Lataste, pp. 63-72. Descriptions de *Termnochelides* de l'Amerique meridionale, par A. Leveille, pp. 76-81. Un nuevo mineral de cobalto (CuO, 2 CoO, Co_2O_3 + 4 H_2O), par Pablo Martens, pp. 87-88. Carta jeolojica, mineralojica y agronomica de Chile, par Alphonse Nogues, pp. 146-164. Reactions chimiques des procedes les plus nouveaux d'traitment des minerals d'or, par Ferdinand Gautier, pp. 176-187. A propos du saut perilleux, par Fernand Lataste, pp. 205-218. Emanations d'acide carbonique et formations calcaires daus les terrains volcaniques, par Ferdinand Gautier, pp. 218-223. Description de deux nouveaux cetaces de la Cote du Chile, par C. Perez Canto, pp. 226-229; 2 figs.

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Congreso Cientifico Jeneral Chileno de 1894, 18x27 cm.; 302 pp. De l'influence de Chlore dans la mineralisation des filons d'or et d'argent, par Ferdinand Gautier, pp. 1-10 Craneos de Indigenas Bolivianos, por L. Vergara Flores, pp. 11-30; 2 pll. Variations de la pesanteur dans une meme localite, par J. A. Krahnass, pp. 31-53. Estudios Ijienicos del aire, por A. E. Salazar y I. Newman, pp. 54-67; 3 pll. Les cornes des mammiferes, par Fernand Lataste, pp. 68-92. Inelques cas Teratologiques observes a l' abattoir de Santiago, par Gabriel Dehors, pp. 93-101; 4 figs. Contribucion al estudio de los microfitos, por C. Perez Canto, pp. 102-118; 5 figs.

GUIANA, BRITISH.

GEORGETOWN, DEMERARA.—*William Chalmers, Crown Surveyor:*

Geological Survey of British Guiana. Notes on British Guiana and its gold industry, by H. I. Perkins, 23 pp.; 4 maps. Report of the government land department for 1895-'96, 19 pp.

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URUGUAY.

MONTEVIDEO.—*Museo Nacional de Montevideo:*

Anales, 20 x 30 cm. I. Memoria Geologica sobre la formacion del Rio de la Plata, por D. A. Larranaga, pp. 3-12. Descripciones de algunos hemipteros heteropteros nuevos o poco conocidos, por Carlos Berg, pp. 13-27. Las Gramineas Uruguayas, por J. Arechavaleta, pp. 29-78; 3 pll.; 13 figs.

V. Las Gramineas Uruguayas, pp. 373-452; 9 pll.

VII. Nuevo Fermento Butyrico, por Vicente Curci, 68 pp.; 3 pll.

Contribucion de conocimiento de la Fauna Uruguaya. Enumeracion de Mamiferos, por Juan H. Figueira, pp. 5-35.

Las Gramineas Uruguayas, pp. 147-392; 37 pll.; 12 figs.

Charles Honore, Author:

Loi du Rayonnement Solaire, por Charles Honore, 356 pp.; 7 pll.

AUSTRALIA.

NEW SOUTH WALES.

SYDNEY.—*Department of Mines and Agriculture:*

Minerals of New South Wales, by A. Liversidge, 17 x 26 cm., 326 pp.; 8 figures; geological map in colors. Bound in green cloth, gilt top, back and side titles.

Memoirs of the Geological Survey of New South Wales, 24 x 30 cm. Geology, No. 5. Geology of the Broken Hill lode and Barrier Ranges mineral field, N. S. W., 1894, by J. B. Jaquet, 150 pp.; 10 pll.

Palæontology, No. 1. The invertebrate fauna of the Hawkesbury-Wianamatta series of New South Wales, 1888, by Robert Etheridge, 21 pp.; 2 pll. No. 2. Contributions to the Tertiary flora of Australia, 1888, by Doctor Constantin, Professor of Botany, University of Graz, Austria, 192 pp.; 15 pll. No. 3. Plant-bearing beds of Palæozoic and Mesozoic age in eastern Australia and Tasmania, by Ottokar Feistmantel, 1890, 190 pp.; 30 pll. No. 4. The fossil fishes of the Hawkesbury series at Gosford, by A. S. Woodward, 1890, 56 pp.; 10 pll. No. 5. Monograph of the Carboniferous and Permo-Carboniferous invertebrata of New South Wales, by R. Etheridge, 1891-'92, 144 pp.; 22 pll. No. 7. The Mesozoic and Tertiary insects of New South Wales, by R. Etheridge and A. Sidney Olliff, 1890, 12 pp.; 2 pll. No. 8. Contributions to a catalogue of works, reports and papers on the anthropology, ethnology and geological history of the Australian and Tasmanian aborigines, by R. Etheridge, 1890-'95, 144 pp. No. 9. The fossil fishes of the Talbragar beds (Jurassic?), by Arthur Smith Woodward, 1895, 40 pp.; 6 lltho. pll., geological section, and 1 photo-lith.

Records of the Geological Survey of New South Wales, 18 x 24 cm., Vol. II, 1890-'91, 180 pp.; 16 heliotype and other plates. Contains numerous geological, palæontological and mineralogical articles.

Vol. III, 1892-'93, 200 pp.; 19 pll.

Vol. IV, 1894-'95, 200 pp.; 24 pll.

QUEENSLAND.

BRISBANE.—*Royal Society of Queensland:*

Proceedings, Vol. XI, 138 pp.; 8 pll. Contains: Aboriginal languages of eastern Australia, by Joseph Lauterer. Geological structure of artesian basins, by A. Gibb Maitland. Albatross bay, by F. C. Urquhart. The flying fox, by Thos. R. Lucas, etc.

VICTORIA.

MELBOURNE.—*Department of Mines, Hon. Henry Foster, Minister:*

Annual Report of the Secretary for Mines, 1894, 21x33 cm., 68 pp.; numerous illustrations, maps, etc.

Annual Report for 1895, 88 pp.; charts, maps, etc.

Special Reports, same size: Report on loss of gold in reduction of auriferous veinstone in Victoria, by Henry Rosales, 65 pp.; 22 pll. Reports on the Victoria coal fields, by James Sterling, 20 pp.; 9 pll. and maps.

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EUROPE.

AUSTRO-HUNGARY.

BRUNN, MORAVIA.—*Naturforschende Verein in Brunn:*

Verhandlungen, XXXII, 1893, 62+273 pp. Beitrage zur Petrographie der mahrisch-schlesischen Basalte, von Josef Klvana, pp. 3-17. Analytische uebersicht der europaischen Arten der Coleopteren-gattung *Epuræa* Er., von Edmund Reitter, pp. 18-36. Bestimmungstabelle der Coleopteren-familie de Cleriden des palæarctischen Faunengebietes, von Edmund Reitter, pp. 37-89. Flora von Serbien und Macedonien, von Ed. Formanek, pp. 146-210. Einige neue Arten aus der Familie der Federmilben, von Hugo Zimmermann, pp. 211-231. Zur Stellung Oncophora-schichten im Miocæn des Wienerbeckens, von. A. Rzehak, pp. 232-273.

Band XXXIII, 1894, 49+262 seiten; 1 tafel. Revision der Coleopteren-gattung *Danacea* Lap. aus der palæarctischen Fauna, von Jos. Prochazka, pp. 7-35; 1 taf. Bestimmunestabelle de Borkenkaefer, von Edmund Reitter, pp. 36-97. Zur Flora von Albanien, Corfu, und Epirus, von Ed. Formanek, pp. 109-159. Phytographische Mittheilungen ueber Pflanzenformen aus verschiedenen florengebieten der Oesterreichisch-ungarischen Monarchie, von Ferd. Schur, pp. 161-251.

XII. Bericht der meteorologischen Commission des naturforschenden Vereines in Brunn. Ergebnisse der meteorologischen Beobachtungen im Jahre 1892, 174 seiten; 6 karten.

XIII. Bericht der meteorologischen Commission des naturforschenden Vereines in Brunn, Jahre 1893, 176 seiten; 5 karten.

BUDAPEST, HUNGARY.—*Magyarhoni Foldtani Tarsulat (Hungarian Geological Societ,):*

Foldtani Kozlony, 18 x 27 cm., XXV, 1895, 400 pp.; 4 heliotype plates. Geologisi uti vazlatok Eszak-Americabol (Geological excursion through North America), irta Dr. Felix J., pp. 5-29; 1 pl. Geologische Reiseskizzen aus Nordamerika (same article in German), von Dr. J. Felix, pp. 69-96; pl. 1, heliotype.

XXVI, 1896, 400 pp., Krystallographischen Kenntniss der Calcites bei Budapest, von Gustav Melczer, pp. 79-94; 2 pll. Westfalischer Carbonpflanzen, von Johannes Felix, pp. 165-178. Vorkommen und die Verbreitung der *Gryphaea esterhazyi* Pavay, von Dr. Anton Koch, pp. 360-366.

Kir. Magyar Termeszettudomanyi Tarsulat (Royal Hungarian Society of Natural Science):

Zweiter internationalen Ornithologen-congress zu Budapest veranstalteten Austellung der ungarischen Vogelfauna, von Dr. Julius v. Madarasz, 16 x 24 cm., 124 seiten; mit 12 original-skizzen.

Cypridicola parasitica, nov. gen., nov. sp., ein neues Raderthier, von Dr. E. v. Daday, 18 x 26 cm., 32 seit.; 1 taf. Separatabdruck aus "Termeszetrajzi Fuzetek," 1893, band XVI, hefts 1, 2.

Die Pyroxen-andesite des Csebat, eine petrographische und geologische studie, von Dr. Franz Schafarzik, 18x26 cm., 192 pp.; 9 tafeln. Separatabdruck aus den "Mittheilungen aus dem Jahrbuche der kgl. ungar. geologischen Anstalt," band IX, pp. 185-376.

A Charafelek (Characeæ L. Cl. Richard) kulonos tekintettel a Magyarorszagi Fajokra, irta Dr. Filarszky Nandor, 23x31 cm., pp. 1-77; with German translation, die Characeen mit besonderer rucksicht auf die in Ungarn beobachteten Arten, von Dr. Nandor Filarszky, pp. 81-129; 5 colored plates; 20 figures.

A Szel Iranya a Magyar szent korona orszagaiban, irta Hegyfoky Kabos, 23x31 cm., pp. 1-54; with German translation, ueber die Windrichtung in den lændern der ungarischen Krone, nebst einem Anhang ueber Barometerstand und Regen, von Jakob Hegyfoky, pp. 55-173; 18 figures and 5 charts.

Ungarische Naturwissenschaftliche Gesellschaft—Mathematische und naturwissenschaftliche Classe:

Berichte aus Ungarn XI, 1892-'93, 508 pp.; 25 litho. plates; 1 heliotype. Contains articles on biology, chemistry, mathematics, and physics.

Band XII, 1893-'94, 478 pp.; 3 pll. Contains articles on biology, chemistry, mathematics, and physics.

PRAG, BOHEMIA.—*Konigl. Boehmische Gesellschaft der Wissenschaften—Mathematisch-naturwissenschaftliche Classe:*

Jahresbericht fur das Jahr 1894, 52 pp. Ueber gewisse Hauptaufgaben der Naturwissenschaften, von Dr. Anton K. Gruenwald, 1895, 68 pp.

Jahresbericht fur das Jahr 1895, 60 pp.

Sitzungsberichte fur 1894, 300 pp.; 23 litho. plates; 18 figs. in text. Das Reductionsgesetz der Bluethen, das Dedoublement und die Obdiplostemonie, von Lad. J. Celakovsky, 142

pp.; 5 pll. Aperiodischen Schwankungen der temperatur im Gebiet des Pic du Midi und Puy de Dome, von Friedrich Klengel, 67 pp. Flora von Bulgarien, von J. Velenovsky, 29 pp. Beitrage zur Kenntniss boehmischen Hydroptiliden, Fr. Klapalek, 10 pp.; 1 pl.

Sitzungsberichte fur 1895. Zur Anatomie der Paraphyse des Wirbelthiergehirns, von F. K. Studnicka, 13 pp.; 1 dbl. pl. Beitrage zur Paleontologie des alteren Palaeozoicums in Mittelboehmen, von Friedrich Katzer, 17 pp.; 2 pll. Beitrage zur electromagnetischen lichttheorie, von Franz Kolacek, 31 pp. Monographie der fossilen Flora von Rossitz in Mahren, von Friedrich Katzer, 26 pp. Beitrage zur Anatomie und Entwickelungsgeschichte des Vorderhirns der Cranioten, von F. K. Studnicka, 42 pp.; 7 dbl. pll. col. Bedeutung des Organes der Stylommatophoren, von J. F. Babor, 20 pp.: 2 pll. Funfter Nachtrag zur Flora von Bulgarien, von J. Velenovsky, 12 pp. *Baculus* Lub. und *Hessella* Br., von Al. Mrazek, 17 pp.; 2 dbl. pll. Studie o Isopodech, Bohu mil Nemec, 46 pp.; 4 dbl. pll. col. Beitrage zur vergleichenden Histologie und Histogenese des Ruckenmarkes, von. F. K. Studnicka, 32 pp.; 3 dbl. pll. col. Ueber neue Wirbelthiere aus der Permformation Boehmens, von Anton Fritsch, 17 pp.; 1 fig.

WIEN (VIENNA), AUSTRIA.—*Kaiserliche Akademie der Wissenschaften:*

Anzieger, 16x24 cm., 1895, Nos. 19–27, pp. 199–290. 1896, Nos. 1–27, pp. 1–268.

Naturwissenschaftlicher Verein:

Mittheilungen, 1893–'94. Ueber lose mit einander Verwachsene Gypskrystalle von Leitmeritz, von Attokar Lanecek, pp. 11–17; 2 figs. Ueber das Hirn der anthropoiden Assen, von Bruno Sellner, pp. 28–57; 1 pl. 1895–'96, 112 pp.; 2 maps.

BELGIUM.

BRUXELLES.—*Societe Belge de Geologie, de Paleontologie, et de Hydrologie:*

Bulletin, 16x24 cm. Tome VIII, Annee 1894, 284 + 204 + 84 pp.; 8 pll.; 14 figs. Les Sources des vallees de l'Ourthe du Hoyoux et du Bocq, par E. Putzeys, pp. 6–45; 4 figs. Sur les preuves d'une submersion de l'Europe occidentale et des cotes de la Mediterranee a la fin de la periode glaciaire, par R. Storms, pp. 54–72. Sur la decouverte d'une Icthyosaure de grande taille a Arlon, par A. Lechien, pp. 76–82. Sur l'importance et la nature des eaux dans les terrains calcaires du Condroz et de l'entre-Sambre-et-Meuse, par M. Walin, pp. 90–113. Les Bryozoaires du Senonien de la carriere de l'arche de Leves, pres Chartres, par E. Pergens, pp. 131–140, 181–192; 3 figs. Examen hydrologique des bassins du Hoyoux et du Bocq, par Th. Verstraten, pp. 141–165; 7 figs. Decouverte de la faune de Mont sur Marchiennes, par X. Stainier, pp. 176–180. Sur la formation de la dolomie, par C. Klement, pp. 219–224. Le Forage Artesien de l'Hotel des chemins de fer, a Bruxelles, par Ch. Lahaye, pp. 252–260. Note sur le gisement des diamants de Fleurus, par X. Stainier, pp. 262–267; 3 figs. Memoires: Etude sur le bassin houillier d'Andenne, par X. Stainier, pp. 3–22. Geologie de la cote Belge, par A. Rutot, pp. 29–39. Le cours de la Meuse depuis l'ere Tertiaire, par X. Stainier, pp. 83–101; 1 pl. L'excursion dans les Jurassique et Triassique, par V. Dormal, pp. 102–127; 7 figs. Synchronisme des couches Maastrichtiennes et Senoniennes de Belgique, par A. Rutot, pp. 145–190; 6 figs.

La Societe Linneenne de Bruxelles:

Bulletin, 18x28 cm., vingtieme annee, Nos. 1-9, 88 pp. Vingt-deuxieme annee, Nos. 1-9, 80 pp.

Societe Royale de Botanique de Belgique:

Bulletin, tome trente-deuxieme, 1893, 202+122 pp. Memoires: Biologie de la vegetation sur le littoral Belge, par Jean Massart, pp. 7–43; 4 phototypic plates, de 10 vues. Excursions rhodologiques dans les Alpes in 1893, par François Crepin, pp. 44–100. Primitiæ Floræ Costaricensis, par Th. Durand et H. Pittier. Lichenes, par J. Mueller, pp. 122–173. Musci, par F. Renauld et J. Cardot, pp. 174–201. Comptes Rendus: Musci exotici novi vel minus cogniti, a MM. Renauld & Cardot, pp. 8–40.

Tome trente-troisieme, 1894, 247+182 pp. Memoires: Rosae hybridae, par François Crepin, pp. 7–149. Embryologie vegetale, par Jean Massart, pp. 150–247; 4 litho. pll.; 54 figs. Comptes Rendus: Musci exotici novi vel minus cogniti, a F. Renauld et J. Cardot, pp. 109–137. Flore Cryptogamique de Belgique. Lichens, par G. Lochenies, pp. 153–172.

Tome trente-quatrieme, 1895, 341+165 pp. Memoires: Tableau comparatif des algues de Belgique, par E. de Wildman, pp. 22–50. Excursions rhodologiques dans les Alpes, par François Crepin, pp. 51–124. Champignons coprophiles de Belgique, par El. Marchal, pp. 124–149; 2 litho. pll. Un Botaniste in Malaise (a botanist in Malaysia), pp. 151–341; 6 phototypic plates de 18 vues; 39 illustrations. Comptes Rendus: Inflorescence des Rosa, par François Crepin, pp. 32–52. Musci exotici vel novi cogniti, a F. Renauld et J. Cardot descripti, pp. 57–78.

LIEGE.—*La Societe Geologique de Belgique:*

Annales, Tome XXI, 1893–'94. Bulletin et liste des membres, cxx+25 pp.

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FRANCE.

BEAUVAIS.—*Charles Janet, Auteur:*

Etudes sur les Fourmis, les Guepes, et les Abeilles, par Charles Janet, 1895, 58 pp. Dito, 26 pp.; dito, 140 pp.

Sur les nids *Vespa* L., par Charles Janet, 1896, 4 pp. Sur la *Vespa crabro* L., par Charles Janet, 13 pp.

BORDEAUX.—*Societe Linneenne de Bordeaux:*

Proces-Verbaux, Vol. XLVII, 1893, 190 pp. Vol. XLVIII, 1894, 88 pp. Vol. XLIX, 1895, 84 pp.

CAEN.—*L'Academie Nationale des Sciences, Arts et Belles-Lettres de Caen:*

Memoires, 1893, 379 pp. Experiences d'acoustique, par M. Neyreneuf, pp. 3-12.

Memoires, 1896, 418 pp.

La Societe Linneenne de Normandie:

Bulletin, 1895, 306 pp. Les organisms precambriens du massif Breton, par A. Bigot, pp. 8-14. Nomenclature des tissues secondaires, par O. Lignier, pp. 15-30. Quelques plantes nouvelles pour Normandie, par Auguste Chevalier, pp. 62-76. Catalogue des annelides polychætes, par Pierre Fauvel, pp. 121-146.

Bulletin Mensuel de la Commission Meteorologique du Calvados. Observations faites a les observatoires du Jardin des Plantes, Sainte Honorine-du-Fay, etc., tous les jours de l'annee 1895, 48 pp.

CHERBOURG.—*Societe Nationale des Sciences Naturelles et Mathematiques du Cherbourg:*

Memoires, Tome XXIV, 1892-'95, 408 pp. Liste de Coleopteres trouves dans les environs de Cherbourg, par F. Nicollet, pp. 53-78. Anomalies des orchidees, par O. Penzig, pp. 79-104; 10 figs. Nomenclature hepaticologique, par Auguste le Jolis, pp. 105-182. Revision des acariens des regions arctiques et descriptions d'especes nouvelles, par E. Trouessart, pp. 183-205. Hepaticæ Chinensis, par F. Stephen, pp. 207-228. Nomenclature bryologique, par Auguste le Jolis, pp. 229-328. Contributions a l'histoire des ampharcticus Francaise, par Pierre Fauvel, pp. 329-348.

DIJON.—*Academie des Sciences, Arts et Belles Lettres de Dijon:*

Memoires de l'Academie de Dijon, 1895-'96, 486 pp.

LA ROCHELLE.—*L'Academie de la Rochelle—Societe des Sciences Naturelles de Charente-Inferieure:*

Annales de 1895. Flore de France, Tome II, par G. Rouy et J. Foucaud, 350 pp.

Annales de 1896. Flore de France, Tome III, par G. Rouy et J. Foucaud, 384 pp.

LUXEMBOURG, LUX.—*L'Institut Grand Ducal de Luxembourg:*

Publications de l'Institut—Section des Sciences Naturelles et Mathematiques. Tome XXIV, 235 pp.; 2 pll. Theorie de l'electricite et de la lumiere de Maxwell, pp. 28-70.

LYON.—*La Societe Linneenne de Lyon:*

Annales, nouvelle serie, 18x28 cm. Tome XXXVII, Annee 1890. Les coquilles marines (Gastropoda, Scaphopoda, Lamellibranchiata, Brachiopoda) des cotes de France. Description des familles, genres, et especes, par Arnould Locard, 384 pp.; 348 figs.

Tome XL, 1893, 215 pp. Mœurs et metamorphoses d'insectes, suite, par le Capitaine Xambeu, pp. 1-52, 101-188. Etude sur la polydactylie chez les Mammiferes, par Louis Blanc, pp. 53-88.

Tome XLI, 1894, 220 pp. Esquisse de la partie inferieure des Terrains Jurassiques du department de l'Ain, par Attale Riche, pp. 1-104. Mœurs et metamorphoses d'insectes, suite, par Capitaine Xambeu, pp. 107-156. Expose d'une classification teratologique, par Louis Blanc, pp. 157-200. Description des mollusques Quaternaires noveaux, par Arnould Locard, pp. 201-220; 29 figs.

Tome XLII, 1895, 270 pp. Expose d'une classification teratologique, suite, par Louis Blanc, pp. 1-48. L'empoissonment des animaux d'eau douce, par Raphael Dubois, pp. 49-52. Mœurs et metamorphoses d'insectes, par Capitaine Xambeu, pp. 53-100. Etudes geologiques sur les monts Lyonnais, par J.-A. Cl. Roux, pp. 101-139. Decouverte d'une nouvelle espece d'Acerotherium, par M. Elie Mermier, pp. 163-189; 1 pl. Etudes geologiques, par Edouard Jacquemet, pp. 199-253.

MARSEILLE.—*Societe de Horticulture et de Botanique de Marseille:*

Revue Horticole—Journal des travaux, Vol. XLI, 1895, 216 pp. Vol. XLII, 1896, 208 pp.

METZ, LORRAINE.—*L'Academie de Metz:*

Memoires, XXIV annee, 1894-'95, 432 pp.; 2 pll.

PARIS.—*Museum d'Histoire Naturelle:*

Bulletin, 1895, Nos. 1-3, 136 pp.; Nos. 6-8, pp. 125-350. 1896, Nos. 1-8, 410 pp.

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TOULOUSE.—*L'Academie des Sciences et Belles-Lettres de Toulouse:*

Memoires, Tome VI, 1894, 540 pp. Anatomie comparee. Construction des Arcs inferieurs de la tete, par A. Lavocat, pp. 22–48. Des bourgeons des plantes dans leurs rapports avec la terminaison des axes, par D. Clos, pp. 77–93. Theorie des groupes des substitutions, par Ed. Maillet, pp. 258–281. Sur une famille de courbes gauches, par H. Molins, pp. 394–420.

Tome VII, 1895, 724 pp. Monotremes, par A. Lavocat, pp. 47–63. Surfaces reglees, par Victor Rouquet, pp. 117–140. Physostatique du Sorezois, par D. Clos, pp. 242–301. Groupement orogenique des chainons Pyreneens, par J. Caralp, pp. 561–576.

GERMANY.

BERLIN, PRUSS.—*Botanischer Verein der Provinz Brandenburg:*

Verhandlungen, XXXVII, Jahrgang, 1895, 254 pp.; 1 pl.

Botanische Beobachtungen aus der Provinz Brandenburg im Jahre 1894, von C. Warnstorf, pp. 34–61. Die Ustilagineen der Provinz Brandenburg, von P. Magnus, pp. 66–97; taf. I.

Entomologischer Verein in Berlin:

Berliner Entomologische Zeitschrift, Band L, 1895, 380 pp.; 5 pll. Die Anthomyidengruppe *Homalomyia* nebst ihren Gattungen und Arten, von P. Stein, pp. 1–141. Dipterologische studien, von Th. Becker, pp. 171–264, 313–344; 1 pl.; 4 figs. Canarische Insekten, von E. von Rebens-Paschwitz, pp. 265–276; 2 taf. Coleoptera nova exotica, von A. F. Nonfried, pp. 279–312.

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Vol. LV, 1894. Fenological observations in Finland, made between 1750 and 1845, by Adolf Moberg (in Swedish and Latin), xii + 165 pp.

Vol. LVI, 1895. Finnish vocabulary, by Herman Vendell, 524 pp.

Ofversigt af F. V. S. Forhandlingar, 14x22 cm., Vol. XXXVI, 1893-'94, xviii + 314 pp. Observations on night frosts, by S. Lemstrom (in Swedish), pp. 88-119. Reply to same, by Th. Homen (in Swedish), pp. 127-153. Climatological notes, by Ad. Moberg, pp. 199-229.

Vol. XXXVII, 1894-'95, xxiv + 288 pp. On uroxansyra, by E. E. Sundwig (in Swedish), pp. 1-18. Action of equimolecular solutions on the mucus of the small intestine, 37 experiments, by Dr. Arthur Clopatt (in Swedish), pp. 93-126; 1 litho. A similar article in French, 34 experiments, by the same author, pp. 127-143. Some new species of Australian mosses, described by V. F. Brotherus (English and Latin), pp. 149-172. The preparation of photografic star plates at the observatory at Helsingfors from June, 1893, to May, 1895, by Anders Donner (in Swedish), pp. 183-200.

Societas pro Fauna et Flora Fennica:

Acta, 15x23 cm. Vol. IX, 1893-'94, 474 pp.; 5 pll. No. 1. Symbolæ ad mycologiam fennicam, by P. A. Karsten (Latin), 11 pp. No. 2. Hymenoptera of the region around Lake Ladoga, by A. Westerlund (Finnish), 30 pp. No. 4. Psocidæ of Finland, by O. M. Reuter (in Swedish), 50 pp.; 1 pl. No. 5. Contribution to the knowledge of the species of *Hieracium* of Finland, by Magnus Brenner (in Swedish), 43 pp. No. 7. Macrolepidoptera of Finland, by Enzio Reuter (in Swedish), 85 pp. Contribution to the knowledge of some Ciliata, by K. M. Levander (in German), 87 pp.; 3 pll. No. 8. Neuroptera of Finland, by O. M. Reuter (in Swedish), 36 pp.

Vol. X, 1894. Monographia Cladoniarum universalis, by Edw. Wainio, part II (Latin), 500 pp.

Vol. XI, 1894, 315 pp.; 10 pl. No. 2. Cladocera of the vicinity of Helsingfors, by K. E. Stenroos (in German), 45 pp.; 1 pl. No. 3. Vegetation on the islands in the Bothnian

gulf, by Ossian Bergroth (Swedish), 78 pp.; 1 map. No. 6. Catalogue of the Odegoniaceæ of Finland, by Karl E. Hirn (in German), 24 pp.; 1 pl. No. 11. Contribution to the knowledge of the flora of Kimito valley, by P. Hj. Olsson (in Swedish), 50 pp.

Vol. XII, 1894-'95, 327 pp.; 6 pll. No. 1. Species of *Hieracium* of Finland, by M. Brenner (in Swedish), 57 pp. Nos. 2 and 3. Water fauna in the vicinity of Helsingfors. Protozoa and Rotatoria. By K. M. Levander (in German), 187 pp.; 6 pll. Northern Piloselleæ, preparatory to a new flora of Finland, described by J. P. Norrlin (Latin), 83 pp.

Herbarium Musei Fennici, 15 x 23 cm., second edition. I. Plantæ vasculares, curantibus Th. Sælan, A. Oswald Kihlman, Hjalmar Hjelt, 156 pp.; 2 pll. II. Musci, curantibus J. H. Bomansson and V. F. Brotherus, 77 pp.; 1 map.

Meddelanden, 15 x 23 cm., Vol. XIX, 1893, 180 pp.; XX, 1894, 128 pp.; XXI, 1895, 146 pp.

Societe des Sciences de Finland—Institut Meteorologique Central (Central Meteorological Institute of the Finnish Scientific Society):

Meteorological observations made at Helsingfors, 25 x 35 cm., all tables. Made in the years 1893-'95, 336 pp.

KAZAN, RUSS.—*Fiziko-Mathematicheskago Obshestva pre Imperatorskome Kazanskome Universitete (Physico-Mathematical Society of the Imperial University of Kazan):*

Bulletin, 16 x 24 cm., second series, tome V, 1895, 356 pp.; 9 pll.

ST. PETERSBURG, RUSS.—*Geological Committee of Russia:*

Bulletins, 16x24 cm. Vol. XIII, 1894, Nos. 1-9 and supplement, 580 pp.; 3 maps. Vol. XIV, 1895, Nos. 1-9 and supplement, 602 pp.; 2 maps; 1 pl. Vol. XV, 1896, Nos. 1-4, 126 pp.

Memoirs of the Geological Committee, 25x32 cm. Vol. IX, No. 3. Fauna of the Lower Oligocene of Ekaterinoslava, by N. Sokolova, 83 pp., with German translation, pp. 84-136, geological section, 24 figures in text, and 4 lithografic plates, of 200 figures of brachiopods, corals, etc.

No. 4. Selachians of the Lower Tertiary of southern Russia, by O. Jaekel, 18 pp., with German translation, pp. 19-35, and 2 litho. plates, 44 figures, of sharks' teeth and vertebræ.

Vol. XIII, No. 2. General geological chart of European Russia, plat 89. Oro-hydrografic sketch of the Viatka valley, by P. Krotova, 228 pp., with German review, pp. 229-241, and orografic map, 44x60 cm.

Vol. XIV, No. 1, 1895. General geological chart of Russia, plats 95 and 96. Geological survey in the Kalmuck steppe in the years 1884 and 1885, by I. Mushketova, 167 pp., with German review, pp. 169-199, and 2 geological charts of the region near the Caspian sea, 54x74 cm., by I. Mushketova and D. Ivanova.

No. 3. Cephalopods from the Trias of eastern Siberian coast province, by Dr. Carl Diener, of Vienna, with German translation, 59 pp., and 5 litho. plates, about 40 figs. of cephalopods.

Vol. XV, No. 2. General geological map of Russia, plat 72, 1896. Geological survey in the valleys of the lower Oka and lower Kliasma, by N. Sibirtseva, 222 pp., with German review, and geological map, 54x74 cm., of the region around Vladimir and Nizhni-Novgorod.

Imperatorskoy Akademia Nauke (Imperial Academy of Sciences):

Bulletin, 21 x 30 cm. Fifth series, Vol. I, September to December, 1894, 201 + 304 pp. Perseids observed at Pulkova in 1893, by Th. Bredihine (in French), pp. 33-59. Observations of the spots on the disk of Jupiter, by W. Serafimova (in French), pp. 131-154; 2 pll. On the parallax of *B* Cassiopeiæ, by S. Kostinsky (in French), pp. 155-164; 2 pll. Crustacea Caspia—Amfipoda, by G. O. Sars (in English), pp. 179-223, 343-378; pll. I-XVI (autografic). Ephemerides of the comet Encke, by O. Backlund (in French), pp. 261-265. Studies on the appearance of the variable star *D* Cephei, by Belopolsky (in French), pp. 267-306; 1 pl.

Vol. II, Nos. 2-5, February to May, 1895, pp. xli-ccxviii, 77-448. Perseids observed in Russia in 1894, by Th. Bredihine (in French), pp. 139-176. Researches on the variations of latitude of Pulkova from 1842 to 1849, and from 1853 to 1875, by A. Ivanova (in French), pp. 257-292, 2 pll. On the measurement of photografic star plates (German), by F. Renz, pp. 293-329. Spiders found by G. Potanine in China and Mongolia in 1876 to 1879, by E. Simon (in French), pp. 331-345. (Descriptions are in Latin.) Blood corpuscles (German), by F. Ousianikova, pp. 365-382; 1 pl. Movement of substances emitted by the comets, 1893 II, and 1893 IV, by Th. Bredihine (in French), pp. 383-395; 1 pl. Elements and ephemerides of the planetoid Geraldini (300) for its opposition, 1895, by A. Rodin (in German), pp. 417-422.

Vol. III, June to December, 1895, lxvi + 498 pp. On the elasticity of the molecule, by Prince B. Golitsine (in German), pp. 1-53. Distribution of wind on the surface of the Russian empire, by I. Kersnousky (in French), pp. 59-67. Method of determining the index of refraction of liquids when near the critical point, by Prince B. Golitsine (in Russian), pp. 131-161. Studies on the star cluster C. G. 4294, by Countess N. Bobrinskaia (in French), pp. 163-172; 2 photografic plates and 1 diagram. Crustacea Caspia—Amphi-

poda, by G. O. Sars (in English), pp. 275-314; pll. XVII-XXIV (autografic). Mysidæ, by the same author (in English), pp. 432-458; plates I-VIII (autografic).

Vol. IV, January to May, 1896, lxxxviii + 502 pp. Secular variations of the orbit of the comet 1862 III, by Th. Bredihine (in French), pp. 31-40. The properties of molecules and atoms, by Prince B. Golitsine (Russian), pp. 293-313. On the origin and the orbits of the system of Aquariids, by Th. Bredihine (in French), pp. 345-360. Revision of the genus *Aphanopleura* (Umbelliferæ), by B. Lipsky (in Russian), pp. 373-381. *Valerianellæ* Turkestanicæ, by the same author (in Latin), pp. 383-387. Crustacea Caspia — Amphipoda, by G. O. Sars (in English), pp. 421-489; pll. I-XII.

Memoirs, 25 x 34 cm. Vol. XLII, 1894. Nos. 7 and 8. Calculations and researches upon the comet Encke. Perturbations by the planets Mercury, Venus, Earth, Mars, Jupiter, and Saturn, from 1819 to 1848, by O. Backlund, 332 pp. (French; though nearly all Arabic figures.) No. 9. Studies on heredity, by J. Orchansky, 300 pp., 20 pp. of diagrams. (French.) No. 10. Apparent positions of the sun-spots photographed at Pulkova by B. Hasselberg in the years 1881 to 1888. Prepared by A. Belopolsky and M. Morine, 173 pp. (French.) No. 11. The industry of spiders. Researches of Woldemar Wagner, 269 pp.; 10 lithograph plates, 20 x 28 cm., of 250 figures in natural colors, printed in the highest style of the art. (French.) No. 12. The common birch (*Betula alba* L.), and the morphological importance of the chalazogamy, by Sergius Navashin, 40 pp.; 6 litho. plates. (German.)

Series VIII, Vol. I, No. 9, 1895, same size. Cloudiness of the Russian empire, prepared by A. Shenrok, 300 pp., including 250 pages of tabulated figures; 8 isonephelic charts of the Russian empire. (German introduction.)

Vol. II, 1895. No. 1. The Sclerotinia disease of plants, by Dr. M. S. Voronin, 29 pp.; 5 plates, colored. (German.) No. 2. On the development of the genital canals in *Cobitis tænia* L., and *Phoxinus lævis* Ag., by G. A. Sneider, 20 pp.; 2 plates. No. 3. Meteorological observations made in 1893 along the coast of the Arctic ocean, in Siberia, by R. R. Bergman, 72 pp. (Russian.) No. 4. Direction and velocity of the winds over the Russian empire, tabulated for 196 places by months and seasons, by I. A. Kersnousky, 116 + 135 pp. (Russian.) No. 5. Annual review of the work done at the Central Physical Observatory in 1894, by H. I. Vilada, 84 pp. (Russian.) No. 6. Cyclone paths in Russia for the years 1887 to 1889, by B. I. Sresneusky, 78 pp.; 11 maps of Europe, 20 x 25 cm. (Russian.) No. 7. Positions of the stars *h* and *x* Persei and their environs, deduced from measures upon two photographic plates, by M. Bronskaya and A. Stebnitskaya, 135 pages. (French.) No. 8. Snowfall and precipitation in the upper Volga valley, by M. A. Rickacheva, 46 pages. (Russian.) No. 9. Magnetic observations made on a trip to Urga, in northern Mongolia, in the summer of 1893, by E. V. Stelling, 28 pp. (German.)

Vol. III, 1896. No. 1. Mean annual precipitation, and number of days on which precipitation occurs annually, in the Russian empire, by H. Vilada, viii + 271 pp. (Russian.) No. 2. Extinction of the buffalo (*Bison bonasus* L.) in the forest of Belovesia, by E. Bickner, 32 pp. (Russian.) No. 3. Types of cyclone paths which have traveled Europe during the period of 1872-1887, by M. Rickacheva, 174 pp.; 62 charts of Europe, showing paths of storms, wind directions, isobaric lines, and precipitation. (Russian.) No. 5. New applications of continued fractions, by A. Markova, 52 pp. (Russian.) No. 6. On the radiation point and polarization of the X-rays, by Prince B. Golitzine and A. Karnozhitsky, 13 pp.; 14 pll. (German.) No. 7. Improved construction of magnetic unifilar theodolites, by H. Vilada, 32 pp. (German.) No. 8. Histological studies of the isopods, by V. Martinova, 16 pp.; 1 double size pl. (Russian.) No. 9. Density of the snow at Ekaterinburg, by G. Abeliss, 28 pp. (Russian). No. 10. On a differential equation, by A. Markova, 18 pp. (Russian.)

Vol. IV, 1896. No. 1. Monograph of *Aspirotricha* (*Holotricha*), by V. T. Sheviakova, 430 pp.; 7 litho. pll. (Russian.) No. 2. On the brachiopod genus *Obolus* Eichw., by August Mickwits, 224 pp.; 3 pll. (German.) No. 3. Coprophagi about Moscow, by E. A. Bogdanova, 52 pp.; 8 pll. (Russian.) No. 4. Vegetation of Turkestan, by S. Korjinsky, 116 pp.; 2 pll. (Russian.)

Historico-Philologique Classe:

Memoires, 20 x 30 cm. VIII series, Vol. 1, Nos. 1, 2, 264 pp.

Imperatorskago Mineralogicheskago Obzhestva (Imperial Mineralogical Society):

Transactions, 16 x 25 cm. Vol. XXXI, 1894, 436 pp.; 1 pl.; 2 portraits.

Vol. XXXII, 1895, 304 pp.; 10 litho. pll. Contribution to the knowledge of the genus *Plyctodus* and tribe Thyestidæ, by Dr. J. Victor Rohon, 64 pp.; 2 pll. (German.) On crystals, by A. Karnozhitsky, 112 pp.; 4 pll.

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SPAIN.

BARCELONA.—*Real Academia de Ciencias y Artes:*

Boletin, 23x28 cm., Nos. 12-14, pp. 187-261.

Memorias, 23x28 cm. Tomo I, 1894-'95. XIX. Applications of kinematic geometry, by Luis Canalda, pp. 331-348. Recognition of the coexistence of the first bottom of the Mediterranean sea in the lower Miocene deposits, by Dr. Jaime Almera, pp. 349-394; 1 geological table, 34x50 cm. Monograph of the species of the genus *Pecten*, by Dr. Jaime Almera and Arturo Bofill y Poch, pp. 395-408; 7 litho. plates.

Tomo II. Flora del Valles, by Dr. Juan Cadevall y Diars, pp. 33-138 (fin.); 1 pl.

Pliocene Deposits of the plain of Barcelona, by Dr. Jaime Almera, pp. 33-80.

Historia de la Academia de Barcelona, cm., 208 pp.

La Casa de Monistrol, 1895, 18x26 cm., 18 pp.

Las Radiaciones de Roentgen, 14x19 cm., February-March, 1896, 14+18 pp.

MADRID.—*Real Academia de Ciencias, Fisicas y Naturales de Madrid:*

Memorias, 20x30 cm. Tomo XVI, 1895, 290 pp. Systematic study of the organic bases of animal origin (ptomaines, leucomaines, etc.), by Dr. Jose Ubeda y Correal.

SWEDEN AND NORWAY.

CHRISTIANIA, NORW.—*Videnskabs Selskabet i Christiania (Academy of Science of Christiania):*

Forhandlinger for 1893. No. 1. Laplandish word-book, by J. K. Quigstad, 372 pp. (in German). No. 2. Political condition of Athens, from the time of Clisthenes to Aristides, by A. Ræder, 151 pp. (Norwegian). No. 3. Histological studies in the Dipsaceæ, by B. Hansteen, 47 pp.; 4 pll. (Norwegian). No. 4. The book of Job—Hieronymus's translation, by C. P. Caspari, 108 pp. (German). No. 5. Plant studies, by Axel Blytt, 52 pp. (Norwegian). No. 6. Athenian writings, by P. Ostbye, 45 pp. (Norwegian). No. 7. Vegetation of Tonsberg fiord, by H. H. Gran, 38 pp. (Norwegian). No. 9. Review of Norwegian ascidiæ, by J. Kiær, 105 pp.; 3 pll. (Norwegian, with English descriptions of the new and unknown species). No. 10. Astronomical, by H. Mohn, 40 pp. (Norwegian). No. 11. Bryological contribution to the flora of Norway, by F. E. Conrad and I. Hagen, 26 pp. (Norwegian). No. 12. Contribution to the anatomy of Combretaceæ, by C. Holterman, 48 pp. (German). No. 13. Norwegian Lepidoptera, by W. M. Sheyen, 54 pp.; 1 map (German; 1,263 species named, their habitats given, and the latitude indicated). No. 16. Norwegian arctic flora, species new or little known, by J. M. Norman, 60 pp. (Latin). Nos. 17 to 20. Various subjects, 116 pp. No. 21. Botanical excursion in Romsdal, by Ove Dahl, 32 pp. (Norwegian). Oversigt, 1893, 80 pp.; 3 engravings. Total pages, 1,436; 18 pll.; 1 map of Norway.

Forhandlinger for 1894. Nos. 1 and 9. Differential calculus studies, by Alf Guldberg, 42+12 pp. (Norwegian). Nos. 2, 4, 5, 6. Various essays, 36 pp. No. 7. On climatic change and the eccentricity theory, by Andr. M. Hansen, 39 pp. (Norwegian). No. 8. On the flora of northern Norway in the regions of Tromso and West Finmark, by E. Jorgensen, 104 pp. (Norwegian). Nos. 3 and 9. Norwegian annelida polychæta, by Olaf Bidenkap, 150 pp. (Norwegian). No. 10. Botanical exploration to Sandmere, on the coast of Norway, 1894, by Ove Dahl, 44 pp. Oversigt, 40 pp. Total, 566 pp.; 3 pll.; 2 half-tone engravings.

Forhandlinger for 1895. No. 1. On a melanistic phase of *Uria grylle*, by R. Collett, 14 pp. (English). No. 2. On four birds, new to the fauna of Norway, found in 1890-'94, by R. Collett, 12 pp. (Norw.) No. 3. *Myodes lemmus* (the lemming): its habits and migrations in Norway, by R. Collett, 64 pp. (English). Nos. 4 and 6. Integration by differentials of the 2d order, by Alf Guldberg, 12+48 pp. (Norw.) Nos. 7-9. Essays in Norwegian, 40 pp. No. 10. Earthquakes in Norway, by Hans Reush, 80 pp. (Norwegian). Oversigt, 48 pp.

Skrifter, 1894, 18x26 cm. I. Mathematic-scientific class: No. 1. Geological studies in the Kongberg district, by Chr. A. Munster, 124 pp. (Norwegian). No. 2. Pendulum observations, by O. E. Shiots, 42 pp. (German). No. 3. On the anatomy of the bulb of *Crinum pratense* Herb., by G. Lagerheim, 8 pp. (German). No. 4. The eruptive rocks of the district of Christiania, by W. C. Brogger, 216 pp.; 4 microphotographs, and 2 maps (German). No. 5. Fresh-water Entomostraca (raised in Norway from dried mud) of New Zealand, by G. O. Sars, 62 pp.; 8 autographic plates, colored from nature (English). No. 6. On Lamy's equation, by A. Palmstroem, 8 pp. (French).

II. Historico-philosophic class: Five papers, by various authors, in Norwegian, German, French, and English languages, 484 pp.; 2 lithographic plates.

STAVANGER, NORW.—*Stavanger Museum:*

Aarsberetning for 1894, 58 pp.; 2 pll. For 1895, 159 pp.

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STOCKHOLM, SW.—*Entomologiska Foreningen i Stockholm (Entomological Society of Stockholm):*

Entomologisk Tidskrift, Jacob Spangberg, Editor. Arg. XVI, 1895, 268 pp.; 3 litho. pll. Arg. XVII, 1895, 300 pp.; 4 pll.

Kongliga Svenska Vetenskaps Akademien (Royal Swedish Academy of Sciences):

Bihang till K. S. V. A. Handlingar, 14x22 cm. Division I, mathematics, astronomy, mechanics, physics, meteorology, and kindred subjects. Blue covers. Vol. XIX, 1894, eight papers, in Swedish, German, and English, 284 pp.; 6 pll. Vol. XX, 1895, eight papers, in Swedish, German, and French, 304 pp.; 9 pll. Two, Nos. 4 and 5, on electrical resonance, by V. Bierknes, 104 pp. (German).

Division II, chemistry, mineralogy, geognosy, physical geography, and kindred studies. Yellow covers. Vol. XIX, 1894, four papers, in English and Swedish, 84 pp.; 3 pll. One, No. 1, on hydrolysis, by J. Shields, 32 pp. (English). Vol. XX, 1895, six papers, in Swedish, 172 pp. Five of the papers are on balloon trips made over Sweden and Finland in 1893 and 1894, with weather records and other observations, by S. A. Andree, who has recently essayed to make a trip to the north pole (Swedish, 148 pp.; 18 pll., maps and charts).

Division III, botany. Green covers. Vol. XIX, 1894, five papers, in Swedish, Swedish and Latin, and German, 448 pp.; 15 pl. Vol. XX, 1895, five papers, in Swedish and German, 136 pp.; 9 pll.

Division IV, zoology, biology, etc. Brown covers. Vol. XIX, 1894, two papers, German, on Neuropora and insects, 40 pp.; 8 pll. Vol. XX, 1895, five papers, in English, Swedish and Latin, and German and Latin, 218 pp.; 8 pll. The first two, on daphnids and sightless crayfishes, by R. Lundberg and E. Lonnberg, are in English, 34 pp.; 3 pll.

Ofversigt, 51st year, 1894, many short papers, Swedish, German, etc., 594 pp. 52d year, 1895, many short papers, Swedish, English, German, etc., 830 pp.

TRONDHJEM, NORW.—*Kongelige norske Videnskabers Selskab (Royal Norwegian Society of Sciences):*

Skrifter, 15x24 cm., 1894, 5 papers, Norwegian, English, and German, 228 pp.; 23 pll. One article, No. 3, on the Norwegian forms of Lithothamnion, by M. Foslie, is in English, pp. 29-208, with 23 photolith. plates, on 10-ply bristol cardboard, with tissue-paper interleaves, and showing about 227 forms, living and fossil.

Skrifter, 1895, 4 papers, in Norwegian and English, xvi+241 pp. One paper, No. 2, on new or critical Lithothamnia, by M. Foslie, is in English, pp. 1-10, with 1 photolith. plate, of 15 figs.

UPSALA, SW.—*Kongliga Upsala Universitet (Royal University of Upsala):*

Arsskrift, 16x24 cm., 1894. Jurisprudence, viii+180 pp. Philosophy, iv+129 pp. Philology, x+121 pp. Program, 1894, pp. 55-110. Natural history in Sweden, by Th. M. Fries, 75 pp. Review of the University, 1893, 118+6 pp.

Arsskrift for 1895. Jurisprudence, viii+71 pp. History, 316 pp. Medicine, 126 pp.; 2 pl. Philosophy, 68 pp. Program, 1895, pp. 111-168. Review of the University, 1894-'95, 88+6 pp.

SWITZERLAND.

BASEL.—*Naturforschende Gesellschaft in Basel:*

Verhandlungen, 14 x 22 cm., Band X, 1894, Heft 3, pp. 512-893; pll. XI-XIV. Glacial deposits about Basel, by A. Gutzwiller, pp. 512-690; pl. XI and XII, geological sections aggregating 280 cm. (German). Catalog of spiders of Basel and vicinity, by F. R. Miller and E. Shenkel, pp. 691-824; pll. XIII and XIV (German).

Band XI, Hefts 1 and 2, pp. 1-420; 5 pll. Ferns collected on the Celebes and adjacent islands by F. and P. Sarasin, by Dr. H. Christ, pp. 1-35, 198-219, 221-258; pll. II, III (German). Fauna of the mountain seas, by Fr. Zschocke, pp. 36-133; pl. I (German). The Jura in the southeastern part of the upper Rhine valley, by A. Tobler, pp. 284-369; pll. IV and V (German).

GENEVA.—*Societe de Physique et d'Histoire Naturelle:*

Compte Rendu des Seances, Vol. XI, 1894, 102 pp. Vol. XII, 1895, 66 pp.

NEUCHATEL.—*Societe Neuchateloise de Geographie:*

Bulletin, 16x24 cm. Tome VIII, 1894-'95, 404 pp.; 6 pll.

SCHAFFHAUSEN.—*Schweizerische Entomologische Gesellschaft (Swiss Entomological Society):*

Mittheilungen, Vol. IX, 1895-'96, hefts 5-8, pp. 227-414. Coleoptera Helvetiæ, by Dr. Gustav Stierlin, pp. 449-576.

ST. GALLEN.—*St. Gallische Naturwissenschaftliche Gesellschaft:*

Bericht, 14x21 cm., 1892-'93, 377 pp.; 2 pll. and portrait of Dr. B. Wartmann. Catalog of the vascular plants of Switzerland, by Joseph Rhiner, Adoxa to Plantago, pp. 175-260

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(German). Plant culture in upper Egypt, by J. Kast, pp. 261-300. Contribution to the mollusca of the cantons Appenzell and St. Gall, by August Ulrich, pp. 301-326.

Bericht, 1894-'95, 416 pp.; 14 pll. Abstract of the second index to the Flora of Switzerland, by Joseph Rhiner, pp. 173-296. Contribution to the tertiary flora of St. Gall canton, by Dr. Robert Keller, pp. 297-324; pll. I-XI. Drumlins, by Dr. J. Fruh, pp. 325-396; pll. XII-XIV.

MISCELLANEOUS.

NEW YORK, N. Y.—*The Electrical Review Publishing Company, Chas. W. Price, Editor:*

Electrical Review, a weekly journal of electrical and scientific progress, 29 x 40 cm., finely illustrated. Vol. XXII, 1893, 344 pp.; XXIII, 1893, 230 pp.; XXIV, 1894, 350 pp.; XXV, 1894, 352 pp.; XXVI, 1895, 404 pp.; XXVII, 1895, 424 pp.; XXVIII, 1896, 344 pp.; XXIX, 1896, 336 pp.

Besides the above books and regular exchanges, catalogues of scientific books are received regularly from the following publishing houses and booksellers:

Joseph McDonough, 53 State street, Albany, N. Y.
Walter F. Webb, Albion, N. Y.
Estes & Lauriat, Boston, Mass.
A. S. Clark, 174 Fulton street, New York, N. Y.
P. Blakiston, Son & Co., Philadelphia, Pa.
Dr. A. E. Foote, Philadelphia, Pa.
Bernard Quaritch, 15 Piccadilly, London, Eng.
Dulau & Co., 37 Soho square, London W., Eng.
Francis Edwards, 83 High street, Marylebone, London W., Eng.
John H. Knowles, 15 Rush Hill Road, Lavender Hill, London S. W., Eng.
Kegan Paul, Trench, Trubner & Co., Paternoster House, Charing Cross Road, London, Eng.
J. B. Bailliere & Fils, 19 Rue Hautefeuille, Paris, France.
Ch. Chadenat, 17 Quai des Grands Augustins, Paris, France.
Gebruder Borntrager, Berlin W., Germany.
Paul Parey, Hedemanstrasse 10, Berlin S. W., Germany.
Mayer & Muller, Markgrafenstrasse 51, Berlin W., Germany.
H. W. Schmidt, Halle a Saale, Germany.
Oswald Weigel, Konigsstrasse 1, Leipzig, Germany.
Ludwig Rosenthal, Munich, Bavaria.

And others.

The following books have been added to the library by purchase:

Cassino's Scientists' International Directory.
Webster's International Dictionary.
The Standard Dictionary.
The Encyclopedic Dictionary, 4 volumes.
The Standard Encyclopedia, 8 volumes.
Pteridophyta and Spermatophyta of N. E. North America.
Illustrated Flora of the Northern States and Canada, 2 volumes (one more to come).

These books are only for reference and will not be loaned out.

Other books are loaned out to members of the Academy on receipt of the necessary postage, which can be learned by correspondence with the librarian.

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Five hundred books, embracing about 900 volumes of our exchanges, have been bound by us during the past two years, in good, substantial and durable bindings. Octavo books are bound in boards, with marbled paper sides and morocco backs and corners. Quarto books are bound with cloth sides and morocco backs and corners. All look very handsome, and the binding insures the safety of these valuable publications.

Colors of covers are various, and mainly without design on the part of the librarian. Only in one case is the color indicative of the character of the contents. For example, all works on botany, forestry, horticulture, and kindred subjects, are bound in green. The only objection to this is that the color is not permanent, in common with other aniline colors with which the materials are usually dyed. Similarly it would seem desirable that other subjects be indicated by the color of the cover. These suggestions are offered: Blue (the sky) for works on mathematics, astronomy, meteorology, etc.; red (the blood) for works on biology, or at least on zoology, anthropology, etc.; brown (the earth) for works on geology, paleontology, etc. Concert of action of some sort is desirable among librarians.

The following is the list as bound:

AMERICA.

Canadian Record of Science, Montreal, Vols. 5, 6. 2 books.
Catalogue of Canadian Plants, Macoun, Montreal, Vols. 1, 2-3. 2.
Transactions Royal Society of Canada, Montreal, Vols. 11, 12. 2.
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CORRIGENDA.

Attention is not called to mere typographical errors where the intention is obvious enough.

On page 6 the date, January 3, 1897, should be January 3, 1896. On same page the name I. B. Ashton should be T. B. Ashton.

On page 29 the first foot-note should be omitted. It was intended for page 28, and is properly inserted there. The stars on page 29 refer to the second foot-note, which should be first (or *) foot-note. The dagger after the name of St. John refers to the last foot-note, which should be second (or †) foot-note.

On plate II supply the words "by Chas. S. Prosser and J. W. Beede."

On page 31, also on page 79, the genus *Fusilina* should be *Fusulina*.

On page 39 Pres. D. S. Kelly, spoken of in the account of the banquet given by the Topeka Philosophical Society, was president of the Academy and professor in the State Normal School, and not president of the State Normal School, as implied in the statement on that page.

On page 68, paragraph numbered 148, *Symphocarpos* should be *Symphoricarpos*.

On page 112 *Gervillia* should be *Gervillea*. On same page O. quadruplicata should be Ostrea quadruplicata.

On page 143, under *U. S. Department of Agriculture*, the name Herbert G. Webber should be Herbert J. Webber.

On page 144, seventeenth line, Waldmar Lindgren should be Waldemar Lindgren; and in the twentieth line W. H. Turner should be H. W. Turner.

On page 145, near bottom, The Henry, the unit of electrical induction, should be written The henry.

On page 148, second paragraph, O. T. Cook, in eighth line, should be O. F. Cook; W. L. Holland, in thirteenth line, should be W. J. Holland; Chas. L. Simpson, in fifteenth line, should be Chas. T. Simpson.

On page 156, second paragraph, under *T. B. Jennings*, W. A. Butler should be A. W. Butler.

On page 157, under BALTIMORE, second paragraph, third line, for "plant" read "planet."

On page 158, fifth line, for T. W. Richards read G. W. Richards. Frederick Charles Moneton, in the seventh line, should be Frederick Charles Moulton.

On page 162, under *Conway MacMillan*, John H. Holzinger and John W. Holzinger should be John M. Holzinger.

On page 166, under *Torrey Botanical Club*, Charles R. Peck, in eleventh line, should be Charles H. Peck. For the word Crytogamic, in eighteenth line, read Cryptogamic. W. L. Britton, in seventh line from bottom, should be N. L. Britton.

On page 167, under *E. W. Claypole*, second paragraph, the name E. A. Claypole should be E. W. Claypole.

On page 168, under PHILADELPHIA, third paragraph, sixteenth line, the genus Fredericia should be *Fridericia*. C. F. Cook, in fifth line from bottom, should be O. F. Cook.

On page 169, third line, William H. Doll should be William H. Dall. In line *Pennsylvania Geological Survey*, I. P. Lesley should be J. P. Lesley.

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On page 172, thirteenth line from top, J. R. Whiteaves, and in fourteenth line J. E. Whiteaves, should be J. F. Whiteaves. Same page, under *Natural History Society of Montreal*, next to last full line of first paragraph, the name R. W. Kingston should be R. W. Brock, Kingston.

On page 175, under TRINIDAD, the name Guffy, occurring four times, should be Guppy, every time.

On page 176, under *Societe Scientifique du Chili*, eleventh line, the genus *Termnochelides* should be *Temnochelides*.

On page 181, under *Deutsche geologische Gesellschaft*, Band XLVII, fourth line, the name Schlieter should be Schluter.

On page 188, next to last line, *Plyctodus* should be *Ptyctodus*.

On page 190, in Entomologisk Tidskrift line, the name of Jacob Spangberg, Editor, should be omitted.

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